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ABSTRACT

These conference proceedings address the current trends, practices, and research in the field of educational technology. Papers and project descriptions are included on the following topics: the use of technology to encourage learning of special needs students; distance education; integrating technology into the curriculum; technology in libraries; computer science education; interactive study strategies; women and minorities in the sciences; setting up and running a classroom World Wide Web server; access to the Internet by the economically disadvantaged; bilingual, multicultural, and English as a Second Language (ESL) education; electronic publishing in education; electronic foreign language education; instructional design; successful World Wide Web searching; using interactive videodiscs to teach math; virtual reality; instructional computing courses; building a computer graphics lab; monetary constraints; university-school partnerships; desktop design; networking courses; programming; teacher training; multimedia; software and hardware adaptations for handicapped individuals; telecommunications; student mentoring; research methods and skills; promoting the use of technology; community partnerships; CD-ROM technology; virtual classrooms; local area networks; asynchronous transfer mode; telecomputing; teacher education; cognitive style and achievement; government information on the Internet; educational standards; online discussion groups; and gender, racial, and cultural issues. Listings include conference, program, and steering committee members; the board of directors; future NECCs; and a description of the 1995-1996 NECA member societies. Author, affiliation, and key word indexes are also included. (SWC)

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NECC '96

Minneapolis

CALL OF THE NORTH

CONFERENCE PROCEEDINGS

National Educational Computing Conference

Minneapolis Convention Center

Minneapolis, Minnesota

June 11-13, 1996

HOSTED BY

Technology and Information Educational Services (TIES)

SPONSORED BY

National Educational Computing Association (NECA)

IN COOPERATION WITH

University of Minnesota
St. Cloud State University
Twin Cities AECT

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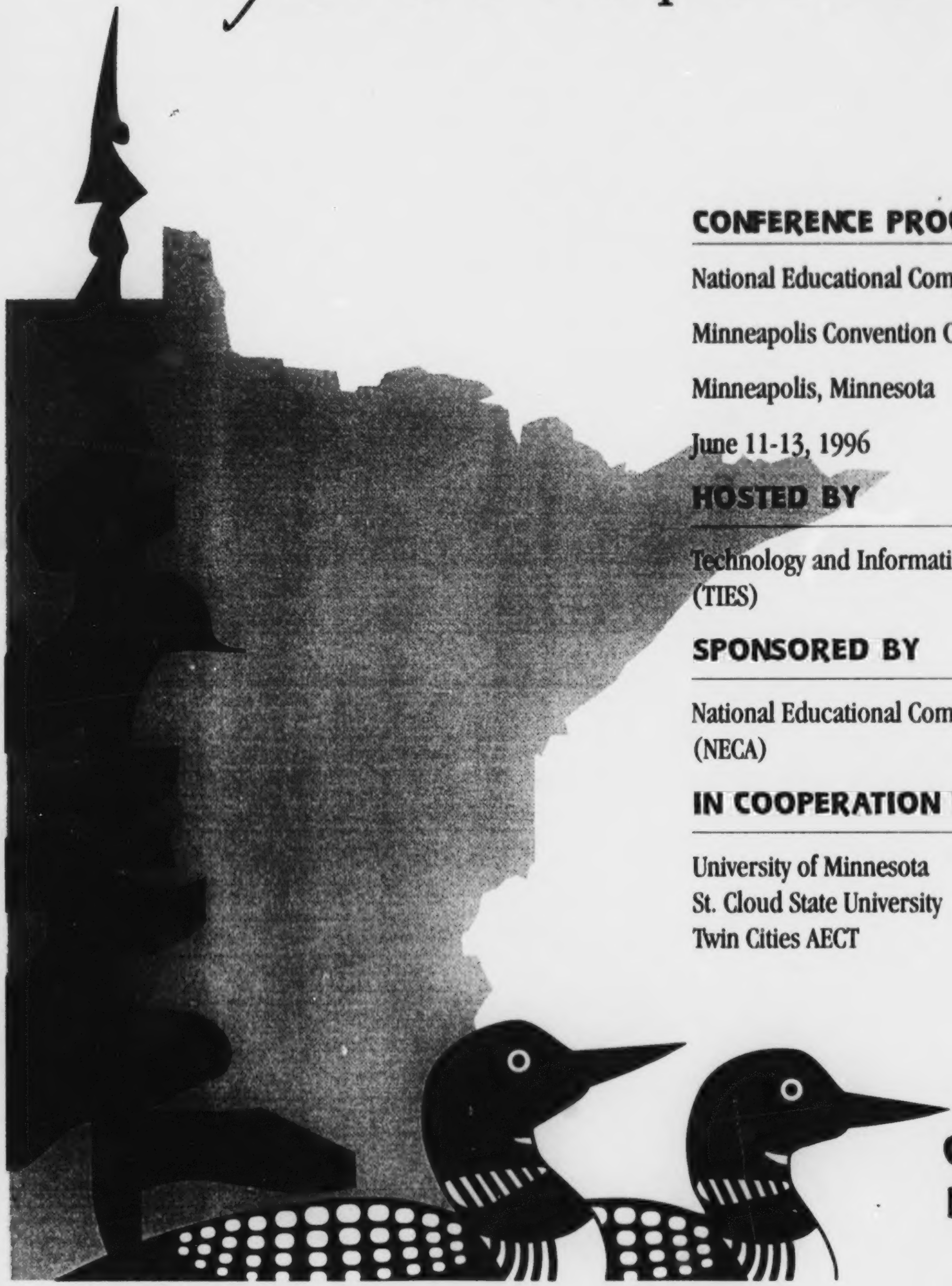

CALL OF THE NORTH

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NATIONAL EDUCATIONAL COMPUTING ASSOCIATION

Conference Chairs' Forward

This volume of the NECC '96 Conference *Proceedings* reports on the trends, practices, and research in the field of educational technology. It provides a snapshot of the National Educational Computing Conference and the state of technology in education at the conclusion of the 1996 school year. This report is the result of the cumulative effort of many individuals around the world.

We would like to extend our thanks to the following individuals and groups for their efforts:

- All of the individuals who submitted proposals and papers for consideration
- Greg Sales (University of Minnesota), Mert Thompson (St. Cloud State University), Don Descy (Mankato State University), Joyce Lindgren (TIES), Lauralee Elnes (TIES), Harriet Taylor, (Louisiana State University), and Ron Young (TIES), for their leadership in providing a broad and diverse program
- The NECC '96 Committee members for their diligence in providing programs and events which contributed to a conference that provided for both professional and personal needs
- The National Educational Computing Association (NECA) for their leadership
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- Greg Bartley (TIES) who had the huge task of coordinating equipment and audio-visual support for the entire conference
- Jim Sydow (TIES) for monitoring our accounts
- John See (Columbia Heights School District) for organizing pre-conference workshops
- Lyne Motylinski (TIES) for developing the framework and providing the leadership for the program committee
- Mike Witkin (TIES) and Marla Davenport (TIES) for their energy and enthusiasm in coordinating the social activities and tours which contributed to the overall conference
- NECC '96 Exhibitors who contributed their financial support, time and expetise
- Paul Katz (University of Oregon Continuation Center) and his terrific team for managing conference exhibits and registration
- Sally Sloan (Winona State University) for her lending her enthusiasm and experience to the program committee and general conference committee.
- Steve Buettner (TIES) for coordinating the Minnesota Showcase
- Sue Soine and Laura Osinski (TIES) for their patience and support in handling of conference details
- Ted Bliven, Wayne Sather, and John Vanderwerf (TIES) for network support
- and a very special thank-you to all of the attendees who made the above efforts worthwhile.

We hope that you enjoy NECC '96 and Minneapolis and find our conference to be the best yet!

Connie Feil and Sheldon Ramnarine
Technology and Information Educational Services (TIES)
Conference Co-Chairs, NECC '96

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1995-1996 NECA Member Societies

The following descriptions are provided for the professional societies/associations that belong to the National Educational Computing Association (NECA). Contact information for each society is given following the society's description.

AAHE—American Association for Higher Education

AAHE is a membership association of individuals interested in improving the effectiveness of the higher education enterprise as a whole and their own effectiveness in their particular setting. The Association's membership includes more than 8,000 administrators, faculty, and students from all sectors, as well as policy makers and leaders from foundations, business, and government.

AAHE is higher education's "citizen's organization," where individuals step beyond their special roles to address collectively the challenges higher education faces. Members share two convictions: that higher education should play a more central role in national life, and that each of our institutions can be more effective. AAHE helps members translate these convictions into action.

Through conferences, publications, and special-interest projects, members acquire both the "big picture" and the practical tools needed to increase their effectiveness in their own setting, and to improve the enterprise as a whole.

Contact: Louis Albert, AAHE, 1 Dupont Circle, Suite 360, Washington, DC 20036-1110, aahela@gwuvm.gwu.edu, http://www2.ido.gmu.edu/aahe

SIGCAS—ACM Special Interest Group on Computers and Society

SIGCAS is the Association for Computing Machinery's Special Interest Group on Computers and Society. With a membership of nearly 1,200, this professional group seeks to identify social and ethical issues raised by computer technology and to provide a forum for discussion dealing with these issues.

SIGCAS publishes a quarterly newsletter, *Computers and Society*, which is a primary source of material on this topic. As a vehicle of communication for the SIGCAS membership, it includes news, comments, and articles on any societal issues raised by computing technology. One of the few periodicals on this subject, it provides a flexible and timely forum for important, evolving topics, such as privacy, equity of access, de-skilling of the workplace, regulation of the Internet, and intellectual property rights.

SIGCAS also sponsors the Computers and Quality of Life Symposium which allows researchers and educators to come together to discuss social and ethical impact issues.

According to a recent membership survey, about 40% of SIGCAS members teach course material on computers and society. In recent years SIGCAS has organized sessions at computer conferences on new methods for teaching the ethical and social impact of computers.

Contact: C. Dianne Martin, EECS Department, George Washington University, 6th Floor, Academic Center, Washington, DC, 20052, diannem@seas.gwu.edu, http://www.acm.org/sig_hp/SIGCAS.html

SIGCSE—ACM Special Interest Group on Computer Science Education

SIGCSE became a special interest group of ACM in 1970. It currently consists of over 2000 members from the educational, industrial, and governmental communities interested in various aspects of computer science education. SIGCSE has goals of encouraging and assisting in the development of effective academic programs and courses in computer science and promoting research in computer science education.

The following are objectives of SIGCSE:

1. To provide a continuing forum for discussion of common problems among education and other computer scientists through organized meetings and symposia.
2. To publish a bulletin at least quarterly containing information aimed specifically at those interested in computer science education.
3. To work closely with the Education Board of ACM to insure implementation of effective education programs by the Association.

Contact: Harriet Taylor, Computer Science Department, Louisiana State University, Baton Rouge, LA 70803-4020, taylor@bit.csc.lsu.edu, http://www.acm.org/sigcse

SIGCUE—ACM Special Interest Group on Computer Uses in Education

SIGCUE provides a forum for the discussion of ideas, methods, and policies related to all aspects of computers in the educational process. Established in 1969 its membership (over 1,400 persons) comes from many countries and numerous, diverse institutions and businesses.

SIGCUE publishes a newsletter titled the SIGCUE *Outlook*. Recent topics have included Preservice Education in Educational Computing, International Reports on Educational Computing, and a Teacher Training Curriculum Project. SIGCUE also sponsors and organizes technical sessions at ACM annual meetings, the National Educational Computing Conference, and other national and regional meetings of interest to its members.

Among SIGCUE's goals are:

1. helping to bring the technical expertise within ACM to bear upon educational computing generally
2. cooperating with other special interest groups or educational societies to promote attention to educational computing issues
3. providing written and verbal forums for members and the educational community to exchange ideas concerning computer uses in education.

Contact: Karen Gould, Metro School District of Wayne Township, 1220 S. High School Drive, Indianapolis IN 46241, http://www.acm.org/sig_hp/sigcue.html

SIGUCCS—ACM Special Interest Group on University and College Computing Services

SIGUCCS provides a forum for those involved in providing computing services on a college or university campus. The topics addressed by SIGUCCS include managing campus computing, computing as it relates to the overall goals of the institution, and the state-of-the-art in various types of college and university computing services, and provides opportunities to discuss and share ideas and experiences with others.

Two annual conferences are regular activities of SIGUCCS. The Computing Center Management Symposium addresses the many aspects of managing computing on campus. This includes hardware, software, planning, finances, and personnel, to name few. The User Services Conference deals more directly with the delivery of particular services to the higher education community. Tutorials on relevant issues are held at both conferences.

In other projects, SIGUCCS offers a Peer Review of the university computing function. Upon request of the computer center director, members of SIGUCCS will formally analyze and comment on different areas of the campus computing function. SIGUCCS also publishes a quarterly newsletter. We consider the newsletter our most important form of communication as it reaches all members and is subscribed to by numerous university computing centers. Conference proceedings are published either as separate documents or as part of the newsletter itself.

Contact: Chuck Chulvick, Computing & Data Services, University of Scranton, 800 Linden Street, Scranton PA 18510, chulvickc1@lion.uofs.edu, http://www.acm.org/siguccs

AECT—The Association for Educational Communications and Technology

The Association for Educational Communications and Technology (AECT) is an international professional association dedicated to the improvement of instruction at all levels through the appropriate use of instructional technology. Founded in 1923, AECT has evolved as an organization as the technology used in education has evolved, from the early use of traditional audiovisual media to today's interactive and multimedia technology platforms. AECT members can be found at all levels of public and private education, from elementary schools to colleges and universities, as well as in the corporate and government sectors.

Organizationally, AECT has nine special interest divisions, eight chapters, forty-six state affiliate organizations, and fourteen national and international affiliate organizations. With over 5000 members, AECT is the largest international association for professionals involved in the integration of instructional technology to the learning process. AECT is the United States representative to the International Council for Educational Media.

Tech Trends, in its 37th year of publication, is the Association's professional periodical. Published during the school year, *Tech Trends* features authoritative, practical articles about technology and its integration into the learning environment. *Educational Technology Research and Development*, the Association's research quarterly in its 40th year of publication, is the only refereed journal focusing entirely on research and instructional development in the rapidly changing field of educational technology.

AECT also publishes reference books on a variety of topics, including practical applications of technology, research, copyright, and standards and guidelines for the field of special interest to instructional technologists.

The AECT national convention and exposition is held each year in January or February, drawing over 12,000 participants and exhibitors. Additionally, AECT sponsors an annual professional development seminar focusing on emerging technologies and a leadership development conference for leaders within AECT and its affiliates.

Contact: Stanley Zenor, AECT, 1025 Vermont Avenue, NW, Suite 820, Washington, DC 20005, 202.347.7834, http://www.aect.org

CAUSE

CAUSE is the association for managing and using information resources in higher education, with a focus on enhancing the administration and delivery of higher education through the effective management and use of information technology.

Through its programs and services, CAUSE serves over 3,600 members on more than 1,200 college and university campuses around the world.

CAUSE member services include:

- Professional Development: through the annual conference, seminars, the CAUSE Management Institute, regional conferences, constituent groups, and recognition programs, including the CAUSE ELITE (Exemplary Leadership and Information Technology Excellence) Award, the CAUSE Award for Excellence in Campus Networking, and the Best Practices in Higher Education Information Resources award program.
- Publications: including the quarterly CAUSE/EFFECT magazine, several newsletters, the CAUSE Professional Paper Series, and other member publications.
- Information Exchange: through the Information Resources Library with more than 2,800 items, including documents contributed by member campuses, CAUSE/EFFECT articles, conference papers, and videos, and the CAUSE Institution Database (ID) Service, a custom reporting service with data about computing environments on CAUSE member campuses.

Contact: Randy Richter, CAUSE, 4840 Pearl East Circle, Suite 302E, Boulder, CO 80301, 303.939.0314, rrichter@cause.colorado.edu, http://cause-www.colorado.edu

CCSC-Consortium for Computing in Small Colleges

CCSC is a not-for-profit organization focused on promoting effective use of computing in smaller institutions of higher education which are typically non- research in orientation. It supports activities which assist faculty in such institutions to make appropriate judgments concerning computing resources and educational applications of computer technology.

Because departments in smaller colleges and universities are usually small and not highly specialized, the Consortium encourages the sharing of expertise, effective curriculum patterns, and efficient technological applications. The Consortium is concerned with the advancement of major programs in both computer science and computer information systems, and with the use of computers in the liberal arts and sciences.

The Journal of Computing in Small Colleges is distributed to faculty in more than 400 colleges across the country. Now in its seventh volume, its five annual issues are averaging 500 pages with articles addressing the broad spectrum of curriculum and computer use in higher education.

Contact: Gail Miles, Lenoir-Rhyne College, Box 7482, Hickory, NC 28603, miles@mike.lrc.edu.

ECMI—Educational Computing in Minority Institutions

ECMI is an organization run by a steering committee representing institutions whose student body reflects a large identifiable minority population. The objectives of ECMI are:

1. Computer literary: To create among the faculty and administrators of the minority institutions an awareness and understanding of the strengths and weaknesses, uses and issues, advantages and disadvantages, feasibility, practicability and limitations of computer applications in all aspects of society, including education.
2. Educational Computing: To narrow the gap which exists between the faculties in minority and non-minority institutions with respect to educational computing know-how and access.

3. Research Computing: To improve the computing facilities available to faculty of minority institutions for research purposes, particularly in those institutions offering graduate programs.
4. Technical assistance—consultants: To provide expert and impartial technical assistance to academic administrators of minority institutions on all phases of academic computing (Instruction and research).
5. Education programs in the computer sciences: To improve the offerings of courses and degree programs in the computer sciences at minority institutions at all levels (e.g., introductory courses, minors, 2-year degree programs, 4-year degree programs, continuing education, graduate programs).
6. Computing facilities: To improve both quality and quantity of computing facilities available in minority institutions, because experience in the non-minority institutions has shown that an adequately staffed and equipped computer center for academic computing is essential to the success of previously stated objectives.
7. Direct student assistance: To increase the availability of minority staff for the computer centers and computer science education programs of minority institutions.
8. The need for a comprehensive program: To facilitate coordination and equitable distribution of funded activities to qualified institutions, associations, etc.

Contact: Jesse Lewis, Academic Affairs, Norfolk State University, Norfolk, VA 23504, j_lewis@vger.nsu.edu.

EDUCOM

EDUCOM is a Washington DC-based nonprofit consortium of colleges, universities, and other organizations serving higher education. Founded in 1964, EDUCOM is dedicated to the transformation of higher education through the application of information technology. Through direct services and cooperative efforts, EDUCOM assists its members and provides leadership for addressing critical issues about the role of information technology in higher education.

EDUCOM's membership includes virtually every major research university in the country: four-year private and public institutions, along with a number of two- year colleges, overseas campuses, foundations, consortia, and research laboratories. Approximately 600 higher education institutions and 110 corporations participate in EDUCOM. Each institutional member appoints a voting representative, who serves as the link between EDUCOM and his or her institution. EDUCOM is completely self-supporting. Funds are generated from membership dues, conferences, publications, consultations, philanthropy, and collaborations.

EDUCOM is committed to the fulfillment of the potential of information technology to realize education that is active and learner centered; free from traditional constraints of time and space; lifelong and collaborative; cost- effective; responsive, dynamic, and relevant; accessible; and outcomes oriented. EDUCOM has historically supported educational networking through computer and communications technology. EDUCOM is committed to shaping the National Information Infrastructure and its uses to enable its effective use by higher education.

EDUCOM's annual conference serves as a forum for sharing concepts, developments, and ideas amongst our community. EDUCOM Review is recognized as the premier source of information on information technology policy and its impact on higher education. EDUCOM also publishes electronic newsletters for the higher education community.

Contact: Ann Messina, Membership Coordinator, EDUCOM, 1112 16th Street, NW, Suite 600, Washington, DC 20036, 202.872.4200, inquiry@educom.edu, http://www.educom.edu

IEEE—The IEEE Computer Society

The Computer Society is the world's largest association of computing professionals, with a total membership of approximately 108,000 computer scientists, computer engineers, and interested professionals. Society membership is open to IEEE members, associate members, and student members and to non-IEEE members who qualify for affiliate membership. An affiliate member is a person who has achieved status in his or her chosen field of specialization and whose interests focus in the computing field.

Every Computer Society member receives *Computer*, a peer-reviewed monthly magazine of general interest to computing professionals which also covers society news and events. Nine specialized magazines and eight transactions are also available to society members as optional subscriptions and to nonmembers, libraries, and organizations.

Magazines published by the Computer Society include *IEEE Computer Graphics and Applications, IEEE Micro, IEEE Design and Test, IEEE Software, IEEE Expert, IEEE Annals of the History of Computing, IEEE Multimedia, and IEEE Parallel Distributed Technology.* Research-oriented transactions include *IEEE Transactions on Computers, IEEE Transactions on Software Engineering, IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE Transactions on Knowledge and Database Engineering, IEEE Transactions on Parallel Distributed Systems, IEEE Transactions on VLSI systems, and IEEE Transactions of Visualization and Computer Graphics.* The Computer Society Press publishes nonperiodical literature, including tutorial texts and conference records. The society's catalog contains approximately 900 titles which are available for purchase.

The society sponsors or cosponsors more than 100 conferences and meetings ranging from workshops and symposia with a few dozen participants to major conferences with many thousands of attendees. Over 30 technical committees offer the opportunity to interact with peers in technical specialty areas, receive newsletters, and conduct conferences and tutorials.

The Computer Society has over 100 local chapters throughout the world, and an additional 100-plus student chapters which provide the opportunity to interact with local colleagues and hear experts discuss technical issues. In addition, tutorials, educational activities, accreditation of computer science and engineering academic programs, the development of standards, and an international electronic mail network all play prominent roles in the society's activities.

Contact: Mike Mulder, Center for Advanced Computing Studies, University of Southwestern Louisiana, PO Box 44330, Lafayette, LA 70504, mulder@cacs.usl.edu, http://www.computer.org/cshome.html

ISTE—International Society for Technology in Education

The International Society for Technology in Education, ISTE, is a non-profit educational organization, with 12,000 individual members and over 60 organization and associate members.

ISTE publishes *Learning and Leading With Technology—The ISTE Journal of Educational Technology Practice and Policy* (formerly *The Computing Teacher), Journal of Research on Computing in Education, CÆLL Journal, Microsoft Works in Education,* and books and courseware for persons interested in the instructional use of computers at the precollege level. These publications emphasize teaching about computers, teaching using computers, teacher education, and the impact of computers on curriculum.

ISTE has a substantial and growing professional outreach program. Five major components currently include:

1. Organization Affiliate Members. Members publish newsletters and/or journals, hold conferences, and directly interact with their own members.
2. Professional Staff. ISTE has a professional staff who write, edit, participate in conferences, process orders, consult by phone or mail, etc. *Learning and Leading With Technology* is put together by a full in-house production staff.
3. Ad Hoc Committees. Such a committee created the "ICCE Policy Statement on Software Copyright" and "Code of Ethical Conduct for Computer Using Teachers."
4. Special Interest Groups. ISTE has organized special interest groups for computer coordinators, teachers of educators, computer science educators, Logo-using educators, telecommunications, and hypermedia/multimedia.
5. Independent Study courses. ISTE offers eleven independent study courses carrying graduate credit from the Oregon State System of Higher Education.
6. Private Sector Council. The Council represents a broad range of corporations and services in an advisory capacity to ISTE's Board of Directors.

Contact: ISTE, 1787 Agate Street, Eugene, OR 97403-1923, 541.346.4414, (fax) 541.346.5890, iste@oregon.uoregon.edu, http://isteonline.uoregon.edu

ISTE SIGTC—The Special Interest Group for Technology Coordinators

The Special Interest Group for Technology Coordinators (SIGTC) is a professional organization that helps technology coordinators meet the challenges of a rapidly changing field. We provide an excellent forum to identify problems and solutions, and share information on issues facing technology coordinators at the precollege level.

SIGTC publishes SIGTC Connections, a quarterly publication, through the International Society for Technology in Education (ISTE). Articles in SIGTC Connections contains helpful information and answers to questions such as:

- What are some ways technology coordinators are successfully organizing and communicating with teachers and administrators?
- What strategies are technology coordinators using to enlist the support of school boards and administrators?
- How do technology coordinators keep informed of new trends and developments in this rapidly changing field?

For general information, contact the ISTE Administrative Office: 1787 Agate Street, Eugene, OR 94703-1923, 541.346.4414, (fax) 541.346.5890, iste@oregon.uoregon.edu, http://isteonline.uoregon.edu

For information on ISTE's SIGTC, contact: Bonnie Marks, Alameda County Office of Education, 313 W. Winton, Hayward, CA 94544, bmarks@ctp.org.

ISTE SIGTE—The Special Interest Group for Teacher Educators

SIGTE is the ISTE Special Interest Group for Teacher Educators involved in educational technology. SIGTE provides a forum for members to share successes, raise questions, and meet the challenges of helping other professionals use technology to enhance learning and education. It publishes a quarterly journal, the *Journal of Computing in Teacher*

Education, that works to provide its members with the answers to practical, leadership, research, and theoretical questions such as:

- What is happening in K-12 computer education that relates to teacher education programs?
- What funding issues are in the fore front of current preservice and inservice teaching areas
- What are the directions in teacher education as related to computer and technology education?
- How can educators become effective critics and implementers of innovations using technology?

For general information, contact the ISTE Administrative Office: 1787 Agate Street, Eugene, OR 94703-1923, 541.346.4414, (fax) 541.346.5890, iste@oregon.uoregon.edu, http://isteonline.uoregon.edu

For information on ISTE's SIGTE, contact: Judy Kull, University of New Hampshire, Department of Education, Morrill Hall, Durham, NH 03824.

SCS—The Society for Computer Simulation

The Society For Computer Simulation (SCS) is the only technical society devoted primarily to the advancement of simulation and allied technology. It has a worldwide membership and a network of regional councils that covers the United States, Canada, the United Kingdom, Europe, and the Pacific Rim.

Simulation is used in every scientific and technical discipline including aerospace, biomedical, business, education, engineering, and manufacturing. Areas that have been specifically recognized as important to SCS members include artificial intelligence, CAD/CAM, education, environmental issues, knowledge based systems, robotics, simulators, and standards.

The society publishes *Transactions of SCS* (an archival journal) quarterly and *SIMULATION* (a journal of applications of simulation) monthly.

Besides the flagship Summer Computer Simulation Conference, (SCSC) the society sponsors several other conferences including the SCS Western Multiconference, the SCS Eastern Multiconference, the Winter Simulation Conference, and the European Simulation Symposium.

Further information about the society can be found on its World Wide Web home page. Those without web access may contact the society by mail, electronic mail, phone, or fax: The Society for Computer Simulation International, P. O. Box 17900, San Diego, CA 92177-7900, 619.277.3888, (fax) 619.277.3930, scs@sdsc.edu, http://www.scs.org

NECA representative contact: Charles Shub, Computer Science Department, University of Colorado-Colorado Springs, Colorado Springs, CO 80933, 719.593.3492, (fax) 719.593.3369, cdash@cs.colorado.edu.

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PROCEEDINGS '96

"Call of the North"

Donella Ingham, Editor

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Project
Shakespeare in Speech, Sign, and Cyberspace

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Key Words: Shakespeare, deaf, reading, CD-ROM, King Lear, sign language, Romeo and Juliet

Background

During the 1993–1994 school year, a group of twenty-four, inner city Deaf students at JHS 47, School for the Deaf, were introduced to Shakespeare for the first time.

All of these students tested far below grade level in reading and writing. Many scored at first or second grade level on standardized tests. Some were considered behavior problems. The age range was fourteen through sixteen.

Listening to the story of *Romeo and Juliet* became a turning point in their lives! It was a story they could relate to. The characters were very real in the eyes of these teenagers. New York became Verona!

Students asked to stay in class later, to hear more. They even came to class at lunchtime! Soon, the most important day of all—the day several students asked to read the story! They looked forward to reading it. Reading was seen in a new light. It was something they wanted to do, not an activity being forced upon them.

Digital Activities

Starting with the full text on CD, an abridged version of each act was prepared by the teacher. The students had access to print and electronic versions of the script. Taking advantage of the digital format, the Shakespearean vocabulary was reinforced with digitized Sign Language Shakespearean "SignBrowsers" were added to the classroom computer so that students could look up Elizabethan terms and see the appropriate Sign Language equivalent. Most compelling though, was the presentation of these digital "Signs" by the students themselves.

While the primary focus was the hands-on study of the text, character, and language of "Romeo and Juliet", we explored ways to support the students' efforts through additional technological strategies. The students participated in developing a series of *HyperStudio* stacks on idioms, Elizabethan culture, dramatic emotions, play structure and

Shakespeare called "Star-Crossed Studies." This featured the students artwork, research, image captures and *QuickTime* clips from the actual Sign Language Production of *Romeo and Juliet.*

With "Star-Crossed Studies", reading was transformed into an enjoyable process—full of surprises. It was no longer limited to the traditional series approach or, even worse, the color-coded level approach. It was an art form and it was theirs to develop and discuss and digitize.

That experience was proof positive that students do rise to challenges! The hidden potential in so many of these students was phenomenal. Students dug into the content of Shakespeare and emerged with wonderful insights. They expressed their discoveries in detailed artwork which they then scanned into the computer to create posters, interactive screens and animations. They videotaped one another signing and used that tape as source material for digital clips and frame grabs to illustrate their Shakespeare research. They learned how to use Boolean tools to narrow their information searches on Elizabethan subjects. And they translated all this knowledge into sensitive dramatic expressions of the characters they portrayed in a full-costume production of *Romeo and Juliet.*

This year, the challenge was extended to a combined group of deaf and limited English proficiency students who are collaborating on the reading and performance of *King Lear.* An instructional videotape and an interactive CD-ROM will be developed using the themes of this play. The student research efforts will now include exploration of the World Wide Web for text and image information on *King Lear*. The digital study created by the teachers and students will also be posted on the WWW in conjunction with the JHS 47's "Special Collection" library on initiatives in Deafness. This will become an interactive resource for other students, both deaf and hearing, who want to study *King Lear* and need extensive visual references to succeed.

Objectives

The primary objective of the **Sharing Shakespeare Project** is to enable Deaf learners to enjoy reading in a new perspective.

The second objective of the **Sharing Shakespeare Project** is to provide a means to enable deaf students to assume a self-directed role in their own education. The third objective is to create an on-site prototype of a technologically supportive environment for the improvement of vocabulary, study habits and a desire to read more.

The fourth objective is to train teachers to use these new tools to develop sign language supported modules to further the study of themes, culture, character and motivation in Shakespeare through a collaborative approach. The fifth objective is the dissemination of these technological tools for educational, linguistic and cultural outreach through workshops, articles and distribution of materials in print and on the World Wide Web.

Impact

Our study of *King Lear* will impact on the entire Special Education population of New York City as well as all special schools connected to the Internet. Students, teachers and parents will be able to access the materials created; and, hopefully, develop innovative ideas for their populations with special needs. Using the WWW as we implement our goals, we can share with others, including posting *QuickTime* clips of the students signing *King Lear*! The most important impact is on the students, themselves. They are already asking which play we'll be doing next year! They are hooked on reading Shakespeare and no longer fear the words. Shakespeare can now serve as a catalyst in developing further skills: Shakespeare leads the students to computers, CD-ROMs, and the World Wide Web, and technology leads the students back to Shakespeare!

Project
CSLabNet: Virtual Laboratory for Introduction to Computing

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Key Words: **asynchronous learning networks, structured laboratories, distributed learning environment, collaborative electronic learning**

Project Overview

The non-majors introductory computing course at Furman University, Introduction to Computing, combines study about computers and computing along with practical laboratory experiences using applications and software tools to solve meaningful informational problems. Like students in most non-majors introductory computing courses, students in this course learn about the technology of computing and develop skills in using applications software. However, traditional courses of this type that are limited to applications such as text processing, spreadsheets, and databases are swiftly losing pace with the development of modern digital informational systems. The 21st century will present a workplace and home significantly affected by the convergence of technologies through computer-mediated communications (CMC). For these reasons, the Department of Computer Science is committed to reforming the course's curriculum to reflect better these recent and important developments in electronic digital information systems and CMC.

In the summer of 1996, the project coordinators will complete work on a National Science Foundation ILI grant which has supported the revision of the educational content of the course to feature concepts derived from multimedia computing, data visualization, and networking. As a part of this redesign, we have employed a separate two-hour structured laboratory session to augment the five hourly lecture classes per week to explore these topics. Indeed, these laboratory activities now comprise the most central component of the course. In addition to the support of the National Science Foundation, grants from the W. M. Keck Foundation and the Kresge Foundation have provided the means for us to assemble laboratory and teaching facilities that support the course's content ably.

The NSF-supported course redesign has succeeded admirably with the new course being embraced enthusiastically by students. Course enrollments illustrate this. Furman students may choose this course as an elective (there is no computing general education requirement at Furman). We are currently able to offer up to 10 sections per year, serving around 300 (in a population of 2500 students). In spite of the fact that the course satisfies no curricular requirements, it is always oversubscribed with waiting lists that match its enrollments.

The high demand for this course has motivated us to explore ways in which we can increase the number of sections offered. The primary limiting factor in this effort is the availability of laboratory facilities. The labs required to support this course are expensive to create and maintain. It is simply not feasible for us to expand the course laboratory facilities sufficient for a doubling of enrollment in this course. This situation is also reflected on other campuses. As part of our NSF-ILI work, we are authoring a text, *Exploring the Digital Domain: An Introduction to Computing with Multimedia and Networking* (to be published in 1996 by PWS Publishing Co., Boston), to support the redesigned course. During this process, we have obtained approximately a dozen reviews of the manuscript from peers at a variety of institutions across the country. The reviews have been very supportive of the text and the course it supports, but one consistent misgiving we hear voiced by reviewers is a concern about whether lab facilities can be assembled to optimize the replication of the course at other campuses. We believe this concern can be alleviated by the creation of an innovative new laboratory structure.

We have created a Virtual Lab environment called *CSLabNet* within which students and instructors may interact and collaborate employing asynchronous CMC networks. In addition to helping solve the laboratory resource availability problem, we believe strongly that the creation of *CSLabNet* is also the next logical step in improving the educational outcomes of the course. Even with our redesign, the course still relied upon the classroom and laboratory as the primary mode of delivery. Of course, lectures are a customary and efficient means for distributing important information, and structured labs are essential opportunities for hands-on experience and better teacher-student interaction. Ironically, though, the lecture and lab are modes that do not always exemplify the use of the technology that they intend to teach. *CSLabNet*, on the other hand, is a vehicle for both exemplifying how CMC works as well as exploiting the educational advantages that this technology offers. And if these distributed learning modes are properly coordinated, we are convinced that we can handle more students with no increase in laboratory equipment and without sacrificing important educational outcomes.

Project Outline

The primary vehicle for delivering information and services on *CSLabNet* is the World Wide Web. The Web's client-server architecture for storing and retrieving hypermedia is ideally suited to our needs. The Web provides instantaneous, cross-platform access to information represented in a variety of forms such as text, graphics, images, sounds, and video. Web documents support modular and nonlinear organizations as well as other types of client-server processes (e.g., e-mail, newsgroups, remote file transfers, etc.). As an added bonus, most of these materials and services are likewise available outside the campus as well. Anyone with Internet access and an appropriate Web client browser can consult *CSLabNet* from any other remote site. *CSLabNet* likewise extends beyond our campus boundaries by offering links to other Web sites that store interesting and relevant resources for the course's study.

[illegible] *CSLabNet,* students are able to access information from labs around the campus, from their dormitory rooms over the campus network, and even off-campus as well. Computer-assisted laboratory instructional modules featuring hands-on activities and tutorials on various topics are available for downloading and self-paced study. As an added benefit, electronic documents including syllabi, assignments, and lectures outlines are also archived for perusal and downloading. Students can ask questions using automated e-mail forms. In addition, electronic conferences can be moderated by instructors for the study and discussion of course topics and issues.

Likewise, students can post information about their term projects and other collaborative laboratory assignments. Thus, these laboratory projects expand the knowledge and information base of the net itself. In short, students and instructors form an electronic community of learners who participate and collaborate in this enterprise.

Future Work

The project is planned for implementation over a two-year period. The basic features above are in place, but many of them are rudimentary and will be significantly enhanced over the next year. Work on HTML publishing, tutorial guides, and maintaining the HTTP server will be supported in the future by a team of three student employees. The student staff will be trained and supervised by the authors. We have already successfully employed similar student work teams to create WWW home pages for various organizations around campus, and we believe this will prove to be an efficient and cost effective way to expand the capabilities of *CSLabNet.*

We should note that *CSLabNet* is intended to augment rather than replace the regular lecture and lab components of the course. Our interest is not to replace traditional learning modes with distance learning, but rather to explore how traditional learning can be improved with distributed learning technology. We believe that these experiences will serve as a useful model for integrating educational technology both on our campus and for other universities and colleges with similar circumstances and mission.

Project

Technology Training at a Distance: A Comprehensive Distance Education Program

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Key Words: **assistive technology, distance, training, degrees, telecasts, materials**

Assistive Technology Training

This project session will feature elements of the accessible education program available from the Research Institute for Assistive and Training Technologies (RIATT). RIATT offers graduate level courses in both assistive and educational technologies, with an emphasis on assistive technology.

Delivery Methods

RIATT uses many different methods of delivery in its accessible education program. This presentation will discuss live broadcasts, packaged video segments, online searches, online discussions, interactive computer programs, and traditional readings.

Courses

In this presentation, Adamson will present excerpts from each of the first eight courses RIATT has offered. These courses are "Overview of Assistive Technology," "Computer Access for Students with Disabilities," "Organizing Assistive and Educational Technology for the Classroom," "Assistive Technology: Switches and Toys," "Family Involvement in Assistive Technology," and "Using Educational and Assistive Technology to Teach Young Children."

Programs and Costs

In this presentation, Adamson will discuss the different options available for students enrolled in these courses. Students can take these courses for in-service training, college credit, or competency certificates. In addition, students can take the entire accessible learning strand and get an Educational Specialist doctorate from the University of New Mexico. Each course is the equivalent of one credit hour. Adamson will also discuss registration and marketing of these courses.

Focus

The 21st Century Elementary Classroom: Integrating Technology and Curriculum

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Key Words: **Integration, curriculum, technology, instruction, elementary**

Plano Independent School District, Plano, Texas, has embarked on a major elementary (K–5) curriculum initiative. The project involves more than 80,000 development hours by district teachers and curriculum coordinators and more than $25 million in projected costs. The purposes of this project include the following goals:

- to integrate curriculum, instruction, assessment, and technology.
- to integrate subject areas into an unified curriculum to be taught for about half of the school day.
- to create six units of study (organizing ideas) per grade level.
- to create an up-to-date technological environment in the classroom.

This project was designed to be a three-year developmental process, with additional time for implementation. The three years will be completed in the summer of 1996.

The development team consisted of five (5) teachers from each of the grade levels, six (6) subject area coordinators, a project manager, a music and art representative, and an instructional technologist specialist. The teachers were supported with the hiring of a coteacher who took the classes in the afternoons so that the teachers could report for the project by 1p.m. each day. During this time, teachers attended training sessions on current brain research and learning theory. They then rewrote curriculum using activity-centered classrooms as models of instruction. They used a mixture of commercial software, custom software, and tool application packages as they developed activities.

The integrated curriculum project is centered on the concept that students will learn better when they see various connections. The result of the project is to provide a student-centered classroom, where students are actively involved in the educational process. The following curriculum model has evolved:

- Overarching Concepts: These concepts link broad, universal ideas, and theoretical structures. They serve as strands that connect concepts and facts within discipline areas.
- Organizing Ideas: These reflect the overarching concepts and provide a unifying frame for sequences of related learning experiences.
- Units: A unit consists of a cluster of activities that are related in terms of concept development, process development, and the development of lifelong learner traits.

A typical scenario might be the following:

Overarching Concept	**Continuity and Change**
Organizing Idea	How Variables Cause Change [About 6 weeks]
Units	Unit 1: What is a variable?
	Unit 2: Using Variables in Solutions
	Unit 3: Variables of the Economy
	Unit 4: Variable Venture

Usually, the first unit includes any introductory material and sets the tone for the unit. It provides relevance and purpose for the student. In the examples above, units two and three usually provide in-depth exploration of concepts and processes related to the organizing idea through different disciplines. Overt connections are made between the different contents as they relate to the organizing ideas. The concluding unit usually contains some sort of assessment activity that allows students to demonstrate what they have learned. It is expected that various technology-related activities will be employed throughout each unit.

The Curriculum Design Center is a portion of the administrative center that was allocated to this project. This is where the teachers reported each day to work on the project. Their hours were from 1p.m. until 4p.m.. Each grade level (K–5) was given a cubicle which consisted of the following:

- a computer for each of five teachers on the team.
- a table for discussion and development that provided workspace for the five teachers and the coordinator assigned to the team.
- storage for various resources to be used in the developmental process.

In addition to the curriculum design center, each teacher was supported in the project with the following technologies:

- Computers: Seven (7) per classroom [486/80 Processor, 8mb RAM, 500mb HD, Super VGA]. This allowed the district to move into a windows environment.
- Sound cards
- Video equipment: VCR, videodisc player, CD-ROM drive
- Large screen monitor with cart

In the second year of the project, each of the teacher's teammates at the school received the same equipment. In March, 1995, a bond was passed to allow the rest of the 1,100 classrooms to receive the same equipment.

In conclusion, the project has combined creative and committed teachers with both human and technological resources to create a "new curriculum" to prepare students for the 21st century.

Project

An Interactive Macintosh Program Designed to Provide a Self-Help Orientation to the Southwestern College Library

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Key Words: **multimedia, orientation, community college, library, Macintosh**

Southwestern College (SWC) has experienced an increase of students who are not prepared for the rigors of college level academics. Many of SWC's 15,000 students begin a program of study unfamiliar with doing research or even negotiating the library. The attrition rate of such students is extremely high. As a thorough working knowledge of the college library is a positive aid to student retention, Bill Alexander, Dean of Instructional Resources; Tim Alexander, now a librarian with TALX, Inc.; and Ron Vess, the SWC Bibliographic Instruction Librarian, developed a classroom enhancement and an interactive Macintosh kiosk built to be user-friendly. The goal is to catch at-risk students, even those who do not know they are in need.

The library maintains a Bibliographic Instruction program, delivering in excess of 300 one-hour group orientation sessions per year. Even with this success it is not catching all who are in need. Large numbers of students for whatever reason cannot, or do not, attend these sessions. In addition to these presentations, a one unit nine-week course is offered, but still all those in need are not served. To help these students, the new stand alone system is available whenever the library is open and is designed to give easy access to elemental information on most aspects of the library's operation.

In the beginning, 100 photographs were digitally encoded by Kodak onto a PhotoCD. A player and a television thus became an "electronic slide projector" to enhance orientations in the library classroom. The images were then imported to the Macintosh so *Macromedia Director* could add text, animations and *QuickTime* movies to create an interactive program. The project started in 1992, has grown to 105 MB on disk, and was installed for student use on March 6, 1995. A Fund for Instructional Improvement grant from the California Community College Chancellor's Office initially supported the project. A Spanish version will be installed early in 1996 with new *QuickTime* and *QuickTime* VR movies. A demonstration CD may then be sold at cost.

Paper

Teaching Computer Science: A Problem Solving Approach that Works

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Key Words: **pre-programming, problem solving, teaching, computer science**

Abstract

The typical programming course is not an appropriate first course for many students. Results indicate that our skill-based approach to computer science is a better preparation for the traditional first programming experience than even prior programming. (This work was partially supported by the National Science Foundation under grant DUE-9254186.)

1. Introduction

As evidenced by typical texts used in the CS1 first course in computer science, the traditional method of introducing computer science concepts is through programming. We believe that several factors indicate another approach is justified if we are to meet the needs of a diverse student population. At many institutions, the range of students, in terms of preparation, abilities, interests and motivation, is wide. Figure 1 shows a low rate of successful course completion (final grade of C- or better) in the first programming class. Note, over half of the majors in the College of Business and "other" colleges were unsuccessful. In addition, there is poor retention of students in the successor courses; for example, one academic session saw 204 students enroll in the second quarter of the CS1 sequence and only 107 complete.

Our contention is that a programming course used as the first exposure to computer science not only discourages many who are overwhelmed by what is required, but that it gives a distorted picture of the profession. For many students in CS1, it appears that rather than learning the basic concepts of the field, their energies are devoted to learning syntax. Rather than learning real problem solving skills, they resort to trial-and-error. Rather than "getting the big picture" of computer science, they narrow their focus to "getting this program to run."

Our data indicate that students with minimal prior computer experience face an almost insurmountable challenge in CS1. When the success of students was compared by experience level (Figure 2), only 22% of those with minimal previous experience were found to be successful in completing the course. One surprising fact is that any kind of computer experience (word processing, game playing, spreadsheets) is helpful;

over 50% of students with merely applications experience were successful in the first programming course. Since many of these activities have no established relationship to programming, one may conclude that the learning curve of computer familiarity is too steep to be scaled quickly by many students.

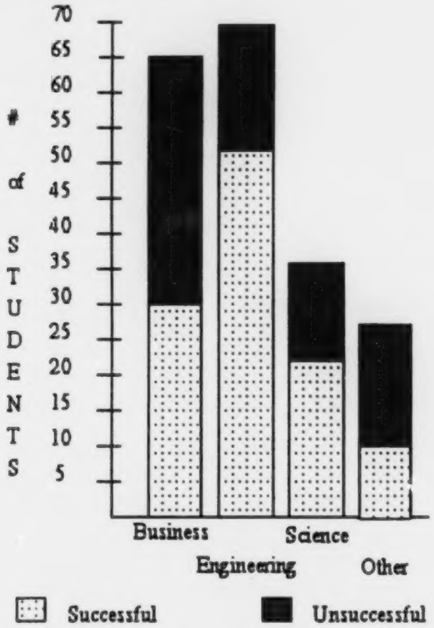

Figure 1. Performance in CS1 by college

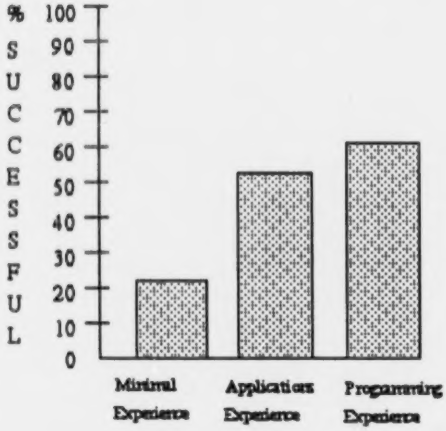

Figure 2: Relationship of prior experience to success in CS1

Students in a typical CS1 course must learn about the computer system, the programming environment, algorithmic problem-solving, top-down design in addition to the basic concepts like booleans, control structures, and mathematical representation, to name a few. Finally, they must appropriately apply all this knowledge, and more, to the solution of a problem, while at the same time attempting to meet the requirement of syntactical correctness. Obviously, there are many students who are capable of this feat. But there are also many who are not capable or are not willing to expend the vast amount of effort needed. The latter make up our target population.

Many students in the programming sequence, even those who do well, report they find the sequence overly time-consuming and difficult. The ratio of time spent to concept learned is high; there is a great deal of frustration involved. If we consider the knowledge gained per hour of effort, programming without proper preparation ranks very low.

An additional factor indicating the need for another approach to introductory computer science is the low number of women seen in CS1. Of 322 students completing the first programming course less than 15% of the students were women (Statistics were taken from the 1993–1994 calendar year.). Historically, the percentage of women in computer science has been low, especially considering that mathematics experiences little gender difference [Fre90]. At Utah State University where 47% of the student body are women, 49% of 130 math majors are women. In math education, 71% are women, whereas in the traditional math major 40% are women. In contrast, of 243 computer science majors at USU, only 12% are women. At the graduate level, the percentage of women increases slightly to 14% of the 142 graduate students.

2. A Preparatory Course

We have developed a preparatory course, CS0, to be taken before the CS1 course. The course includes a laboratory experience, in keeping with recommendations found in the report of the NSF Workshop on Undergraduate Computer Science Education [NSF89]. Our intent was to develop a course that would stimulate the students to understand the issues before being asked to adopt a particular set of rules, to cause them to ask the question before being given the answer. Our goals were to furnish a firm foundation in the mathematical and problem-solving skills, teach some of the major computer science concepts needed for success in CS1, and give the hands-on experience that seems important for such success.

Class time is divided between lecture and work in small groups. Student interaction is highly encouraged. Instead of relying solely on the traditional lecture method where material is laid out for the students, we incorporate the Socratic method, where concepts are developed by questioning the students and building on their answers. This approach is quite successful in the humanities [Bat90] and has been used successfully for teaching mathematics [Pol71].

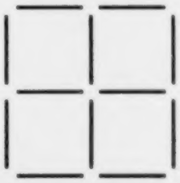

Figure 3: Move three toothpicks to create three boxes. All toothpicks must be used.

3. Course Strategies

The way we have juxtaposed ideas and slanted the coverage of certain topics differs from the norm and may serve as a launch pad for others' ideas.

3.1 Problem Solving and Problem Solving Strategies

Some students come to the first programming course without adequate problem-solving skills or with a poor understanding of the basic mathematical and logical tools needed for problem-solving. This situation has been recognized at all levels of education [Boa86]. The problem-solving experience of many students is confined to rote application of rules or use of standard equations.

In addressing the question of fostering problem-solving skills, it is our intent to motivate student interest by using a "recreational math" approach which has been used successfully in formal mathematics [Rub86, AC80]; challenge students with "brain teasers" and then give them the analytical tools to make solution easier. We attempted to implement the approach of "example, imitation and practice," which, according to Polya, is the only way to learn problem-solving [Pol62]. However, the problems are such that they have no specific solution pattern to follow. Rather than memorize, "When a problem has this characteristic, the solution looks like this," students practice the development of skills that apply to a wide range of problems.

We compiled a list of the skills used by good problem solvers [LGK89, Lev88, Man89, Pol62, Rub86, Suy80], then selected and designed activities and problems to foster those skills. This list includes:

1. They use self talk. They ask themselves questions, think aloud, and brainstorm.
2. They begin with what they understand and use all information.
3. They have acquired the knowledge of necessary subject matter.
4. They refer to the problem statement frequently.
5. They draw on other information and knowledge.
6. They employ lengthy sequential analysis when a question is initially unclear.
7. They create mental pictures and use physical aids to thinking.
8. They relate problems to familiar or concrete experiences.
9. They carefully proceed through a series of steps to reach a conclusion.

One particularly effective technique, self-talk, is stressed as students are encouraged to think out loud, ask themselves questions, recap what they have done and why. Many students have never thought about how they solve a problem. Thus, requiring them to vocalize the process is useful.

An exercise in problem solving uses the pattern of toothpicks and the problem statement shown in Figure 3. As students ask themselves a series of questions, the solution emerges. Do all the squares have to be the same size? (Probably. Only three can be moved, so there is little opportunity to construct different sized squares.) Can I have some lines hanging off? (No. All lines must be used.) Can I put toothpicks on top of each other? (Maybe, but that approach would only move two toothpicks.) Since each square takes four lines and there are twelve lines total, it appears that there are no common sides. (Yes, this is the beginning of the solution.) Throughout the course, as the class worked on problem-solving activities, the instructors encourage presentation of different approaches. Students are invited to journal their homework problem-solving activities.

A major problem-solving assignment involves the use of a spreadsheet. We ask students to analyze a set of demographic data collected on class members the first week of class. After learning the basics of using the spreadsheet package, students meet in study groups to discuss data analysis and to devise strategies for using the data. Students receive a copy of the assignment along with a study guide that includes discussion questions that attempt to stimulate critical thinking [KA95].

3.2 Computer Science Principles

Our approach to introducing basic concepts needed for computer science such as data types, internal representation, operators, propositional logic, algorithms, control structures, programs and subprograms and recursion is to use multiple ways of presenting the concepts. To present these concepts, we use various combinations of lecture, readings, pencil-and-paper exercises (individual and in small groups), spreadsheet labs, reading and modifying code (JoJo Dancer) and programming in ML. This multifaceted approach enables us to reinforce the perception that it is the concept itself that is important, not the syntax. Some specific examples follow.

The similarity between the spreadsheet cell and a variable is easily seen and provides a simple way to introduce variables. Constants are illustrated using the "cell protection" feature of the spreadsheet. Since a spreadsheet cell can contain an alphanumeric label, a numeric value or a formula, the concept of data types is motivated. Students see the need for data types before being asked to supply them in a program. The necessity of explicitly indicating strings can be shown with label entries consisting of digits. For example, the entry of a phone number, 555-5555, displays -5000, unless it is specified as an alphanumeric. By changing the display format of a numeric entry, the student comes to consider how a value entered as 24.329 can be displayed as an integer, a fixed-point value, or in scientific notation.

ML identifies data types as the data are entered, giving an immediate reinforcement of the data type concept, and also permits the definition of enumerated types and lists. The latter feature allows the instructors to emphasize the difference between the data type and an instance of that data type. After having manipulated integers, reals and strings, the student experiments with the enumerated type, gender, with values defined as male and female. Students are asked to explain the difference between male and "male."

While arithmetic operators are natural to students, the concept of relational and logical operators that produce boolean results is difficult for many students. Spreadsheets are an excellent way to introduce booleans and some basic logic at the same time. Seeing the evaluation of a relational expression displayed as 0 (false) or 1 (true) is a concrete, meaningful illustration for most students. The same is true in ML which displays the value true or false along with the type bool of an expression. Construction of truth tables in the spreadsheet is quick and allows evaluation and investigation of complex expressions. One useful example is the demonstration of DeMorgan's law as students are asked to demonstrate that not (a<b or c=0) does not have the same truth values as (a, b, or c 6= 0).

The built-in spreadsheet functions like SUM and AVERAGE serve to introduce the concept of list operations as well as to facilitate the presentation of subprograms and parameters. In this context, it makes perfect sense to students that when they ask for the SUM, they must specify what is to be summed. ML, as a functional language, is especially well-suited for an exposition of parameters. In addition, ML has a built-in list data type and has list operations defined, (e.g. hd and tl).

Common events are the keys which open the door to the study of algorithms. An in-class activity has students design an algorithm for roasting a marshmallow. Students are exposed to the concepts of conditionals and loops controlled by compound conditions without being burdened with having to understand the problem statement. Improper design of loops leads to "unhappy campers" who end up eating charred remains! Having a student (or, even better, the instructor) follow a student-designed algorithm for tying a shoelace leads to some humorous contortions. It is not until later that more formal algorithms designed for machine-solution are introduced.

An introduction to spreadsheet macros serves as a powerful, hands-on illustration of the value of creating reusable procedures. The idea is further enhanced in ML where the function big (find the larger of two numbers) is used to write the function biggest which finds the largest of 4 numbers. It receives its fullest expression in JoJo Dancer, where the entire program consists of function calls. The fact that the student never sees the code for these functions highlights procedural abstraction. In lab, students follow instructions for the construction of a subprogram using the pre-coded functions and are asked to develop an original subprogram in a homework assignment.

Control structures are covered in numerous ways. Use of the spreadsheet IF function and the if-then-else in ML allows students to examine the selection control structure. In the spreadsheet, the capability of copying formulae with relative cell references makes the demonstration of iteration very simple. For example, the Fibonacci numbers can easily be generated iteratively: in the first two rows of a column (A, for example), enter the first two Fibonacci numbers (both 1); in the third row, enter the formula to add the previous two numbers(A3 =+A1+A2); and, copy the formula into as many cells in the column as desired. An investigation of the formulae stored in various cells, e.g. A7=+A5+A6, points out the repetition of the same operation with different values. Construction of other series, such as the series approximation of ex, allows the student to "program" relatively complex iterative problems with little concern for syntax. Comparing the results obtained by "programming" the series for x= -.01, and that obtained from the spreadsheet's built-in function EXP(-.01) leads to a discussion of round-off error and the effects of different computational methods.

In addition, control structures are explored as students read and modify C code which manipulates a graphical dancer. The use of single statements, composite statements and nested loops is seen as students modify the number of kicks, splits, or head tilts which JoJo performs.

ML, with its list data type and operators, makes recursion easy. We have found that by introducing recursion right along with iteration, students are open to accepting it as just another approach to solving a problem and acquire a good grasp of the notion.

	#	Precursor GPA	CSI GPA	% A's CSI
All CSI	683	none	2.6	30
Basic	92	3.0	2.3	26
CSO	30	2.8	3.2	53

Figure 4: Benefits of CS0 as a Preparatory Course

4. Results

In order to judge the effectiveness of CS0 as a preparation for CS1, a variety of statistics were gathered. We compared the performance in CS1 of students who took CS0 prior to CS1 to that of students who took the BASIC course prior to CS1. Our conclusion is that, not only is CS0 a good preparation for CS1, it is better preparation than a programming course.

Data for students who took the first quarter of CS1 during the period from Winter 1994 through Spring 1995 were analyzed. Students who had previously taken either CS0 or BASIC were noted. Data were collected on 30 CS0-prepared students and 92 BASIC-prepared students.

Figure 4 shows the benefits of CS0. On a four point scale, the average grade for CS1 over the period indicated was 2.6. CS0 students had an average grade of 3.2 in CS1, more than a half grade higher! This is even more impressive when one considers that those who took a college BASIC class before CS1 had an average grade of 2. in CS1. Fifty-three percent of CS0 students who took CS1 got A grades in CS1. Only 26% of the students taking Basic before CS1 received an A grade in CS1. It is interesting that those with BASIC preparation have a lower GPA in CS1 than the average student. This may indicate that students who feel they need a precursor class before taking CS1 are generally weaker and do not perform as well as other students, even after having taken the preparatory course. If this is true, it is even more impressive that CS0 students, who arguably felt a need for preparation, went on to out-perform the average student in CS1.

Since students at any level will spend hours exploring concepts they perceive as entertaining, we tried to motivate learning through a "recreational" approach. Judging from student involvement, the "brain teaser" approach did work. The class was most enthusiastic and responsive during these problem-solving activities. In terms of student interest and involvement, the spreadsheet is another successful class activity. Students report that they enjoy the satisfaction of learning a tool which can be applied to the solution of a variety of useful problems.

5. Summary

It is our experience that a typical programming course is not an appropriate first course for many students. Of all the activities in which a computer scientist is involved, learning a new language is one of the most frustrating. Even someone who has programmed in many other languages and knows what to do to solve the problem, finds it is necessary to stumble through manuals, searching under several possible topics, to find out how to do it. Since initial experiences with programming are often frustrating, resulting in a low rate of successful completion, another approach is warranted. Let the students experience good user-interfaces before they are asked to design one. Show the students how application programs save them work before asking them to spend hours coding a solution they can easily compute with a calculator. Introduce students to basic concepts like data types and round-off error through experimentation with a spreadsheet. Help the students develop problem-solving skills before asking them to apply those skills in a programming environment.

The preparatory class which we have implemented has several advantages. Students gain problem solving skills at the same time they are becoming familiar with the computer as a tool. They receive a more representative picture of computer science as a discipline without becoming confused by the details of syntax. Student understanding of top-down design, data structures, recursion, process abstraction, and other concepts central to computer science are of benefit throughout their undergraduate experience. Results indicate that this skill-based approach to computer science is a better preparation for the traditional first programming experience than even prior programming.

References

[AC80] B. Averbach and O. Chein. "Mathematics Problem Solving through Recreational Mathematics," Volume 1 of *Mathematical Sciences*. W. H. Freeman, New York, 1980.

[Bat90] W.L. Bateman. "Open to Question: The Art of Teaching and Learning by Inquiry." Jossey-Bass Publisher, San Francisco, 1990.

[Boa86] National Science Board. "Report of NSB Task Committee on Undergraduate Science and Engineering Education." March 1986.

[Fre90] K.A. Frenkel. "Women & Computing." *Communications of the ACM*, 23(11):34–46, November 1990.

[KA95] M.V. Kolesar and V.H. Allan. "Teaching Computer Science Concepts and Problem Solving with a Spreadsheet." In *Proceedings* of SIGSCE '95, pages 10–13, March 1995.

[Lev88] Marvin Levine. "Effective Problem Solving." Prentice Hall, Englewood Cliffs, New Jersey, 1988.

[LGK89] F.K. Lester, J. Garofalo, and D.L. Krol. "Self-Confidence, Interest, Beliefs, and Metacognition: Key Influences on Problem-Solving Behavior," Chapter 6. In D.B. McLeod and V.M. Adams, editors, Mathematical Problem Solving: A New Perspective, chapter 6, pages 75–88. Springer-Verlag, New York, 1989.

[Man89] G. Mandler. "Affect and Learning: Causes and Consequences of Emotional Interactions." In D.B. McLeod and V.M. Adams, editors, Mathematical Problem Solving: A New Perspective, chapter 1, pages 3–19. Springer-Verlag, New York, 1989.

[NSF89] NSF. "Report on the National Science Foundation Disciplinary Workshops on Undergraduate Education." April 1989.

[Pol62] G. Polya. "Mathematical Discovery: On Understanding, Learning, and Teaching Problem Solving," Volume 1. John Wiley and Sons, New York, 1962.

[Pol71] G. Polya. "How to Solve It; A New Aspect of Mathematical Method." Princeton University Press, Princeton, NJ, 1971.

[Rub86] M.F. Rubinstein. "Tools for Thinking and Problem Solving." Prentice-Hall,Englewood Cliffs, NJ, 1986.

[Suy80] M.N. Suydam. "Untangling Clues from Research on Problem Solving." In S. Krulik and R.E. Reys, editors, Problem Solving in School Mathematics, chapter 5, pages 34–50. National Council of Teachers of Mathematics, Inc., Reston, VA, 1980.

Society
ASSISTing Undergraduates: Academic Study Strategies Using Interactive Supportive Technology

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Key Words: **study skills, electronic studying, learning disabilities, undergraduates**

Project ASSIST is a three-year model demonstration project designed to implement and evaluate the use of technology-supported, academic study strategies for postsecondary students with learning disabilities. The Project ASSIST model has four major components: (a) personalized instruction and technical assistance on computer-based study strategies for postsecondary students with learning disabilities; (b) intensive access to portable computers configured to support the individual needs of participating students; (c) information and training for post secondary faculty and staff concerning computer-based study strategies for students with learning disabilities; and (d) outreach recruitment to students with learning disabilities not yet in a four-year postsecondary educational setting, with special emphasis on minority and nontraditional students.

Project ASSIST is a collaborative effort between (a) the Center for Electronic Studying in the College of Education at the University of Oregon, (b) the offices and programs for students with learning disabilities at two postsecondary institutions (University of Oregon and Lane Community College), and (c) Oregon's secondary schools across the state. The overall goal of Project ASSIST is to encourage more students with learning disabilities to pursue an academic postsecondary education and ultimately obtain a four-year college degree. To that end, the project is designing, implementing and evaluating a model for enhancing students' skills in using the computer to study and learn across the curriculum. The model program provides students with portable computer technology, work with faculty to increase their awareness of accommodations appropriate for students with learning disabilities, and provide secondary students with a vision of how they can be successful in college settings through the empowering effects of computer-based study strategies.

Project ASSIST addresses two national needs in the field of postsecondary education for students with learning disabilities. First, there is a need to support the increasing numbers of students with learning disabilities who attend institutions of higher education so that they can obtain a college degree. Second, there is a need to explore creative uses of advanced technology for enhancing the success of students with learning disabilities in postsecondary settings. Project ASSIST is designed to provide the field of postsecondary education with a model for addressing both national needs. Expected outcomes are a significant increase in the number of Oregon students with learning disabilities who pursue a postsecondary academic education and a significant improvement in both the level of success and satisfaction with their college education. Through its replication and dissemination efforts, Project ASSIST will extend these benefits to students in other states pursuing education at other postsecondary institutions.

In this presentation we will demonstrate the academic study strategies being used in Project ASSIST and will discuss the results from the first year of the project.

Focus

Connecting Curriculum and Classroom Computers

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Key Words: **connected, curriculum, classroom**

Northbrook School District 28 is a suburban Chicago area K–8 school district with a student population of 1550. Three K–5 buildings and one junior high school comprise the district. Students utilize computers in a variety of subject areas at all grade levels.

Each K–5 school has one computer lab with 24 networked IIGS and 10 Macintosh workstations, Internet access and device sharing is to all Macintosh computers via a wide area network, a high speed modem, a dedicated phone line and printers. The junior high school has two computer labs with Macintosh workstations, Internet access and device sharing is provided to all Macintosh computers via a WAN. Classrooms and most staff offices have at least one Macintosh workstation and a printer. There are also PowerBooks and an ink jet printer available on a mobile cart for student use at each school. Thirty first to sixth grade classrooms are part of the first two phases of the Connected Classroom program started in the fall of 1994. Thirteen more first to fifth grade and five seventh grade classrooms will be added to this program in the fall. The Connected Classrooms each have six Macintosh workstations networked to a color printer. All Connected Classroom computers are able to access the Internet, e-mail and America Online via a wide area network.

Students use technology as a tool for learning in interdisciplinary, literature based classroom settings. A variety of software is used to assist students as they discover, write, analyze, create and present. Word processing, publishing, telecommunication, painting and multimedia programs are used frequently as students discover new ways and master concepts. District 28 recognizes that technology is a necessary tool for assisting students as they prepare for the workplaces of tomorrow.

Student objectives include:

1. Provide access to the tools of technology to facilitate/enhance lifelong learning.
2. Help students develop technological skills which are appropriate to their age, ability level and learning styles.
3. Provide technology access to all students in a variety of curriculum areas to assist in meeting their educational needs.
4. Provide students with access, for educational purposes, to information resources within and outside of the school community.

Technology is used throughout the curriculum with all of the students. Teachers are assisted by Technology Coordinators in providing instruction to students in Connected Classrooms using a team teaching approach. Eight 15 hour profession growth courses are offered throughout the year to staff members to assist them in learning and implementing new technology. Students can be observed traveling through the jungles of Guatemala on the *MayaQuest*, mapping routes in Antarctica through the Blue Ice Project, sending e-mail to a variety of locations, publishing books, creating reports, developing vocabulary, researching, and most importantly building skills that will help them on their way to lifelong learning.

Through the use of online services, including Internet and America Online, students are able to travel to every continent in the world. After teaching students the basics of online programs, searches, and e-mail, we guide them into projects and research that focus on age appropriate skills and curriculum. Trade books and other appropriate literature are utilized in these projects, along with reference CD-ROMs and tool-based software to span a spectrum of curriculum areas. During the 1995–96 school year we followed the Blue Ice Project, *MayaQuest II*, The Journey North, and the NASA Space Program.

Students involved in the *MayaQuest* used the Internet to learn how the cyclists progressed, and what they discovered. Creative writing using *ClarisWorks* and *Inspiration* focused on the trip and research. Students took a first hand prospective as they wrote journals, reports, books and poems. Multimedia was used to create dynamic presentations based on information from the *MayaQuest* and related research. Word searches and crossword puzzles were created by students as they learn new vocabulary. Puzzles were shared with classmates helping all to master the new ideas in a motivating way. Using *Kid Pix 2* and heat-transfer ribbons, students designed shirts with the *MayaQuest* theme. Students were excited about the expedition, and eager to learn more about the region. They mastered many new skills and enjoyed their travel via the computer.

Working with students in the Connected Classrooms, provides the opportunity to view first hand the many positive effects of infusing technology into the classroom. Students are writing more, developing questioning skills, discovering how to locate information from a variety electronic sources, working cooperatively, taking learning beyond classroom walls, mastering word processing, multimedia and other computer skills, using computers as tools, and most importantly being excited about learning. We remind our students often that learning with technology is a journey and not a final destination, so they should enjoy the trip. The learning objectives set up for our students are being met as they develop computer skills and begin their lifelong learning journey.

Project
Hawaii, Minnesota and New York Empowers Educators by Using the Internet

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Key Words: **staff development, curriculum renewal, K-12, HERN, Kalama, distance education, collaboration**

This interactive presentation will highlight the processes and strategies that teachers used to create an effective, integrated (cable, online and school site) staff development model. Participants in this training first hesitated, then embraced the experience and practices, and finally requested more learning experiences in using the Internet as a tool to support their curriculum. This "alternative model" of inservicing focuses on school reform that is dynamically evolving with the support of HERN since Summer 1995.

Participating teachers include: Connie Mark (conniem@kalama.doe.hawaii.edu), Joanne Oshiro (joanneo@kalama.doe.hawaii.edu), Christina Shioi (cshioi@kalama.doe.hawaii.edu), and Alan Takano (alant@kalama.doe.hawaii.edu).

Overview

In Spring 1993, Hawaii's Department of Education (HDOE) embarked on a pilot project, nicknamed Kalama.'Invited practicing teachers planned a statewide student networking system. Implementors of this project faced with new challenges led to a search for information about curriculum and the Internet. Thus, the inclusion of successful models were needed to support this networking effort.

Project participants used the Internet to research how telecommunications was being used within the K-12 environment. At the onset of research in 1993, formal research was not available. However, Frank Odasz, director of Montana's Big Sky Telegraph, shared his online training circuit concept and Texas' TENET's director, Connie Stout provided information about their teacher training and its uses. Concurrently, HDOE expanded the use of their K-12 distance education system for supporting face-to-face staff development.

After hundreds of practicing hours, Hawaii's teachers designed new courses and workshops that would lead to experimenting new modes of thinking that guided the implementation and uses of the Internet between peers and with students.

Why New Models Were Sought

Hawaii's educators began using a statewide electronic mail system as early as 1987 for communication. More familiarity with the technology led to the desire for collaboration between teachers and included student users. Student use promoted the questioning about effective uses. However, teachers wanted time to practice and models to follow rather than "adding-on" telecommunications activities to their daily conventional curriculum and on-going support. In order to maintain the high level of teacher involvement, using the Internet would draw upon national resources to address the local challenges.

Successful Models

After a summer of practicing together and identifying the learning outcomes, the team created "calls for collaboration" by following the Kidsphere and FrEdMail guides. Constant searches and listserv queries led to "meeting" teachers with similar investigations. This experience built the collaboration between Hawaii, Minnesota, and New York in 1995.

Educators in three states—Minnesota, New York, and Hawaii—met online and discovered they were driving down parallel paths. They were looking for ways to renew curriculum that foster interactive dialog, constructivist and cooperative learning processes between learners. Exchanges uncovered the desire to include "built-in" assessments. The three states depended on each other to encourage their prospective teachers to continue experimenting while consulting with one another.

The three models move away from "metaphors of the old media" and are the catalyst for the growing of grass-roots school reform, albeit in mini steps. This groundswell was promoted by a complex question of "How can we use the Internet with students and teachers and become more interactive in our teaching and learning?" Teachers from the three states identified the successful models already in place and the convergence of all three stimulated more enthusiasm.

Minnesota's Web66/Hillside model succeeded by involving students in interactive processes with peers and resources all over the world. New York's Global Education Telecommunications Network Project used the technology to plan for curricular reform and rather than focusing on technically trained Internet users. Hawaii's development of online teacher facilitators for sustainable cable TV and on-site and online mentorship fostered meaningful sustained interaction between researchers and classroom teachers.

These models created a virtual environment to investigate, experiment, consult and evaluate amongst teams as they invent new curriculum models. The synergy encouraged continual discovery for personal growth and curricular reform.

Empowering Change Agents

The following Spring (1994), the original pilot participants encouraged new teachers to form teams at school sites to capitalize on the strengths, teaching styles, and curriculum expertise of the various peers. Supported by online mentoring and interactive cable television sessions, the interdisciplinary team designed the "next level" courses or workshops. Since the educators were adept in using the basic Internet tools, they recognized the need to collaborate with teams who were facing the same challenges for instructional uses.

The teacher facilitators' enthusiasm continually recruits and supports new mentors as they discover new methods of teaching. More importantly the teachers' questions developed the basic educational questions for a new research project called the Hawaii Education Research Network (HERN). This project was awarded a grant from the National Science Foundation's Networking in Education to address the application and infrastructure issues.

Paper

Assessing Change after a Computer Course for At-Risk Students

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Key Words: **computer literacy, at-risk students, hypermedia**

Abstract

In this paper, I plan to describe a computer literacy course that I teach as part of a Pre-freshman summer session for at-risk students. The aims of the course are to teach students how to use computers for all their coursework and to encourage students to be comfortable using technology. I surveyed students on their attitude towards computers both before and after the course to see whether the course succeeded in achieving its goals.

The Pre-freshman Summer Program is a six-week intensive summer session for certain incoming freshman. These entering students are either in HEOP (Higher Education

Opportunity Program) or ACCESS. HEOP is a New York State funded program for educationally and financially disadvantaged students. ACCESS is a special admissions program at the College of Saint Rose for students who do not meet the normal admissions criteria. Students in both programs must attend the summer program. All students in ACCESS and HEOP are regarded as at-risk students, and they are given special attention to help them achieve their goal of a college degree.

During the summer program, students take remedial courses in mathematics and English, take a course on study skills, have individual and group counseling, have mandatory tutoring sessions, and have structured study periods. They also take a computer course.

The computer course meets five days a week for 55 minutes for six weeks. The class meets in a Macintosh teaching lab so that students can use a computer during each class. We keep the class size deliberately small so the instructor has time to work individually with students. Usually there are between twelve and fourteen students in the class. The aims of the course are to teach students how to use computers for all their coursework and to encourage students to be comfortable using technology. The hope is that students will regularly use computers for all their classes until they graduate.

I have taught this course for the past four years. In the first year, I taught students how to use the standard business applications—word processing, spreadsheets, and database. I also taught students how to use a drawing program and there was a small unit on *HyperCard* at the end of the semester.

HyperCard is an authoring program that lets people with minimal programming skills create multimedia applications. All *HyperCard* applications are like a stack of index cards. Each "card" is a screen. The designer can place graphics and text fields on cards. The designer can also put buttons on cards. Buttons can start animation sequences, play programmed music, and play back recorded sounds. Buttons can also connect to other cards to create hypertext documents. *HyperCard* is a Macintosh program, but there is a similar program called *ToolBook* for the IBM platform.

Students enjoyed learning how to do word-processing since this task is obviously important for any college student. The spreadsheet and database programs did not interest the students as much, since these applications seemed irrelevant to them. *HyperCard* interested them greatly. Unfortunately, due to time constraints, students developed a very small project under my close direction. Each student project was the same.

I made a few changes during the second summer I taught the course. I still taught students how to do word processing, but I replaced the business applications software with *MacSolve*. *MacSolve* is a program that supposedly teaches problem-solving and critical-thinking skills. Unfortunately, we found that there were serious bugs in the program. Even without bugs, the programming language syntax in the package was difficult for students to grasp. Students had many problems using *MacSolve*, and were starting to think that computers were hard to use!

Since using *MacSolve* was so counter-productive, I abandoned it earlier than I had planned. This left more time available for an expanded unit on *HyperCard*. In the first week of this unit, I guided students as they created a geography project on the United States. The first card of the stack had a map on it. By clicking a button on top of a state, a card with information about that state would appear. During the class, I guided students as they created this stack. Students also had a handout I wrote that they could use on their own.

In the second week, I asked students to design and implement their own stacks. I encouraged students to experiment. Students added animation sequences, PICT files created using *SuperPaint*, scanned artwork and recorded sounds to their stack. The work fully engaged all students. Students liked using the different peripheral devices, and many students spent much time outside class getting their projects to work. Students especially liked implementing their own ideas. On the last day of class, there was a "show-and-tell" session, so students could try out all projects. I was very happy that students were so independent and were so comfortable using computers to do new tasks.

"See Dick" was the title of the best project that summer. The project's goal was to teach the danger of alcohol and drugs. There were animation sequences that included people drinking from funnels, people smoking marijuana, and people driving cars into trees.

Since using *HyperCard* was such a success, I have had students design and implement their own projects during the past two summers. My syllabus now includes units on *Microsoft Word, SuperPaint,* using the Internet, and *HyperCard.*

The Internet unit is fairly brief. I teach students how to send and receive e-mail, and how to access information using gopher. Last summer was the first semester students used the Internet, and this unit was very popular. Again, students felt very comfortable using technology in a new way.

This past summer, "Broadway Musicals" and "Name The Artist" were the titles of the two best projects. The "Broadway Musicals" stack had an index on its first card. By clicking the name of a Broadway show, the user would go to a card about that show. Each card had a scanned picture from the show's CD cover, a text field that gave a synopsis of the plot, and a button that would play back a song from the show. Each card also had a button that could take the user back to the first card.

The "Name The Artist" stack had a series of cards with questions. Each card had a scanned photograph of a painting or sculpture. The user could click the name of the artist. If the user guessed correctly or incorrectly, they would get a visual response and a musical response. After a correct guess, the next question card would appear. In my classes, trivia games are a fairly common project. What made this stack so special was the care that the student took in designing each card.

I certainly felt that the course was meeting its goals, but I thought it would be useful to assess whether this was true. On the first day of the summer session, I gave students a questionnaire that would test their attitudes on using computers. I also gave the same questionnaire to the students on the last day of the summer session. It was my hope that the course would positively change student attitudes.

The following table contains the survey statements and the mean response. I asked students to answer each statement with 5 if they completely agree, 4 if they somewhat agree, 3 if they neither agree nor disagree, 2 if they somewhat agree and 1 if they completely disagree.

	Initial Response	**Final Response**	**Change**
1. It is easy to break a computer.	3.39	3.63	0.24
2. I know a lot about computers.	2.36	3.19	0.83
3. I know how to write a paper using a computer.	3.82	4.63	0.81
4. I know how to draw using a computer.	2.79	4.56	1.77

5. If I took a computer class in college, I would expect to get an "A."	3.29	3.81	0.53
6. If I took a computer class in college, I would expect to fail it.	1.89	1.37	0.52
7. I am planning on taking at least one computer course while in college.	4.68	4.63	0.05
8. I have taken at least one computer class in high school.	4.29	4.33	0.05
9. I am scared of computers.	2.04	2.15	0.11
10. Computers are easy to use.	2.79	3.48	0.70
11. People like me find computers hard to use.	2.71	2.07	0.64
12. People like me enjoy using computers.	3.71	3.74	0.03
13. I have a computer in my home.	3.14	3.30	0.15
14. Learning about computers is important for my future.	4.82	4.74	0.08
15. I am comfortable learning new things about computers.	4.29	4.41	0.12
16. I can use computers in a creative way.	3.36	4.22	0.87
17. People like me don't take computer classes in college.	1.54	1.74	0.21
18. People like me enjoy learning new things.	4.50	4.48	0.02
19. Using a computer hinders creativity.	2.29	2.04	0.25
20. Knowing how to use a computer will help me get better grades.	4.39	4.44	0.05
21. I hate computers.	1.68	1.74	0.06
22. Only social misfits like using computers.	1.11	1.41	0.30
23. I am good at organizing projects.	3.11	3.59	0.49
24. I would expect to get an "A" in most of my college classes.	3.29	3.37	0.08

The mean change per statement is .37, and the standard deviation of the change per statement is .41. I grouped the statements into three categories. The first category of minimal change included those statements with an average change per statement under .37. This group included statements 1, 7, 8, 9, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, and 24. Of this group, statements 7, 8, 14, 17, 18, 20, 21, and 22 already had a fairly extreme response (either over 4.0 or under 2.0) initially, so attitudes could not change greatly for those statements. For example, the mean response to statement 14 (Learning about computer is important to my future.) was initially 4.82. It could not become much higher!

It is interesting that there was not much change in response to statements 1 (It is easy to break a computer.), 9 (I am scared of computers.), 12 (People like me enjoy using computers.), 15 (I am comfortable learning new things about computers.), 19 (Using a computer hinders creativity.), and 24 (I would expect to get an "A" in most of my college classes.).

The second category of moderate change included those statements with an average change per statement between .37 and .78. Statements in this category included statements 5 (If I took a computer class in college, I would expect to get an "A."), 6 (If I took a computer class in college, I would expect to fail it.), 10 (Computers are easy to use.), 11 (People like me find computers hard to use.), and 23 (I am good at organizing projects.). The first four statements in this group all relate to confidence. Students are clearly more confident using computers than they were before the semester started. It is interesting that the mean for statements 5 (If I took a computer class in college, I would expect to get an "A.") and 24 (I would expect to get an "A" in most of my college courses.) were both 3.29 before the semester started, but were 3.81 and 3.37 respectively after the summer session was over. Students clearly are more confident they will do well in a computer course than they would do in a different course.

The third category of high change included those statements with an average change per statement over .78. Statements in this category included statements 2 (I know a lot about computers.), 3 (I know how to write a paper using a computer.), 4 (I know how to draw using a computer.), and 16 (I can use computers in a creative way.). Statements 2, 3, and 4 are responses to content learning during the semester.

The change in mean response to statement 16 pleases me greatly. This response shows that students view using a computer in a very different light. The response to statement 16 clearly echoes the observation I made in the past that students love to blend graphics, sound, and animation while implementing their own ideas.

The overall change in student attitudes reinforces my belief that students learn content and are more confident when they develop computer applications where they can implement their own ideas. *HyperCard* and *ToolBook* are ideal applications for "computer literacy" courses since these programs let students easily blend sound, graphics, animation, and text.

Paper

An Internet Research Model

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Key Words: Internet, telecommunications, communications, research

Abstract

This paper focuses on basic, advanced, and original research activities of the Internet. Basic research refers to retrieving information from a single, often preselected, online source; advanced research includes a wider variety of sources and involves high-order thinking skills; original research focuses on using the Internet to conduct investigations through surveys and collaborative experiments. Alternatives to online research are also examined and a model is proposed for conducting relevant and meaningful Internet activities.

Introduction

Meaningful Internet activities should take advantage of the distance, multiple resources, and speed that telecommunications can offer. They should also require students to synthesize, analyze, and evaluate the information, rather than simply collecting facts.

Telecommunications projects for K–12 classrooms can be roughly divided into two broad areas—communication and research. Communication-oriented projects include activities such as pen-pals, peer-to-peer tutoring, and electronic publishing (Barron & Orwig, 1995). Advantages of communicating through the Internet include the facts that the costs are minimal and responses to messages can be relatively fast and frequent. Through the Internet, students can interact directly with people throughout the world on a daily basis to gain insights on culture, politics, and living styles.

The Internet is also an enormous resource for educational research activities. With access to international databases, libraries, and experts, students can find and retrieve information on almost any topic. Research-oriented projects include basic, advanced, and original information gathering. This paper focuses on the research activities of the Internet and proposes a model for conducting relevant and meaningful Internet activities.

Alternatives to Online Research

Before jumping into an online research project, it is wise to consider the alternatives. In many cases, investigations through other media, such as traditional libraries, CD-ROM, or video may be more appropriate and more efficient.

The use of online resources need not replace the use of libraries, bookstores, and magazine racks. Textbooks and magazines are often easier to transport, have more reliable content, and include higher quality graphics. In addition, many students prefer to read print that is in hard-copy form with a variety of fonts, styles, and colors.

Conducting research with CD-ROM encyclopedias or databases also has some advantages over conducting research on the Internet. CD-ROMs usually provide a better interface than the Internet, and they can tailor the content to a specific grade level or subject area (Caputo, 1994). In addition, the information is self-contained, and you do not have to worry about students wandering off to information that is inappropriate for young minds.

If the investigations require large amounts of video, a videodisc or videotape may be most appropriate. Although multimedia components are available on the Internet, the transfer time required is considerable and the quality is limited. In most cases, the video clips on the Internet are limited to less than two megabytes and display at less than 15 frames per second in a window that is less than one quarter of the screen. Even with these limitations, it might take 15 minutes or more for a movie that lasts only 15 seconds to download and play on your computer.

Basic Research

Students' initial uses of the Internet will generally involve basic research, which is focused on retrieving information from a single, often preselected, online source. For example, students may participate in an "Internet Hunt" designed by their teacher to practice accessing a Telnet site, or they may access a preselected source, such as the *CIA World Factbook*, to write a research report (Barron & Ivers, 1996).

Basic research provides opportunities for students to learn navigation techniques and to practice different approaches for information retrieval. Time invested in the teaching and practice of the basic skills is especially important for inexperienced researchers. A lot of the frustration associated with initial uses of the Internet can be alleviated with short, structured exercises that help to ensure success.

Example Activities:

- Internet "Treasure Hunts"
- Crossword Puzzles that focus on a few, pre-selected Internet sites
- "Trivial Pursuit" exercises with the Internet
- Research papers that incorporate one or two Internet sites

Advanced Research

Advanced research includes a wider variety of sources (such as several sites on the Internet in addition to print or CD-ROM sources), and the sites are not generally preselected. With advanced research, the students must determine which source or sources should be investigated and have the skills to access and query the sources. Search engines, such as Veronica, Archie, Lycos, and WebCrawler, are important to help students in the search for materials.

In addition to locating the correct information, with advanced research students should be required to analyze the results of their searches, compare the data, and report the information appropriately. They should also begin to question the resources and reject incomplete, inaccurate, or inconsequential information (Barron & Ivers, 1996).

Examples:

- Conduct research about the Holocaust
- Investigate information available about rain forests
- Write a research report about endangered species

Original Research

Original research refers to using the Internet to conduct investigations through surveys and collaborative experiments. The power of original research lies in the fact that the participants can include students, teachers, and community members from all over the world. For example, students may send a survey through a LISTSERV, newsgroup, or e-mail system to collect and compare gas prices, hobbies, school topics, or politics. After the data are collected, they can be graphed, analyzed, and shared with all participants.

Students can also participate in cooperative experiments through the Internet. For example, students in different geographical areas might compare the air quality, chemicals in rivers, soil content, or growth patterns of plants. When conducting collaborative experiments with students in other countries, it is important to ensure that all factors influencing measurements are controlled as much as possible. For example, some locations may have better access to scientific instruments and computers than others. If you plan to compare air quality, it might be necessary to send the same testing equipment to all locations. Through international collaborative experiments, students will learn that some countries use the metric system and others do not, and that electrical currents may be different.

Examples:

- Compare the gasoline prices in various countries or states
- Conduct tests of water samples or air quality in various countries or states
- Analyze ancestry and migration patterns based on biographies

Online Research Model

The procedure for conducting research through the Internet is very similar to traditional research, except that the amount of information available is enormous and online time may be limited. In 1990, Eisenberg and Berkowitz outlined a six-step research cycle for information problem-solving. A similar cycle is very appropriate for Internet searches (see Figure 1).

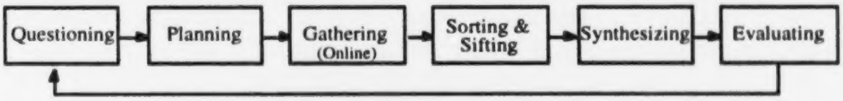

Figure 1. Internet Research Cycle.

1. *Questioning.* Students should structure their research questions and determine their topics of interest before they go online. "Online is the best thing to come down the line in years in the educational field, because it teaches kids to think. For the first time, they have to ask themselves what it is they're really looking for" (Basch, 1993, p. 184). If the research questions are not well-formulated, the students will have little chance of finding relevant information.

2. *Planning.* With careful planning, valuable time and energy can be saved when the students get online. They should narrow their research questions, select potential sites, and outline a search strategy.
3. *Gathering.* Next, the students connect to the Internet to retrieve the information. There is a tremendous amount of information on the Internet and it is easy for students to acquire mountains of extraneous data. Students should be taught to quickly assess the potential relevance of the information before capturing or downloading it.
4. *Sorting & Sifting.* After the students have collected the information, they should sign off the system and carefully analyze the information. This step can take a substantial amount of time because the information must be categorized, accepted, or rejected. Another important component of this step is for students to assess the reliability and validity of the information. "The Internet is far from perfect. Largely unedited, its content is often tasteless, foolish, uninteresting, or just plain wrong" (Elmer-DeWitt, 1995, p. 10). Figure 2 includes some possible data sources on the Internet and important questions to consider in relation to the validity.

	Newsgroup	**LISTSERV**	**Database**	**Electronic Journal**	**FTP site**
Source	Individuals	Individuals	Institutions	Publishers	Individuals
Edited?	No	No	Usually	Usually	No
Refereed?	No	No	Sometimes	Usually	No
Available in Print?	No	No	Sometimes	Usually	No

Figure 2. Sources of Information.

5. *Synthesizing.* After the relevant information is selected, the students should attempt to form some conclusions through the integration of the data that addresses the research questions.
6. *Evaluating.* Finally, students analyze the information to determine if the research question has been adequately answered. In many cases, additional research may be necessary, and the cycle will begin again, with a revised research question and additional sites to search (McKenzie, 1995).

Conclusion

Basic, advanced, and original research projects can provide relevant and meaningful ways for your students to learn the basics of search and retrieval techniques and to acquire information on a variety of subjects. Before considering online research, other alternatives should be investigated. When online is the most appropriate option, it should be implemented in a procedural fashion to ensure maximum benefit for the students.

References

Barron, A. E. & Ivers, K. S. (1996). *The Internet and Instruction: Ideas and Activities.* Englewood, CO: Libraries Unlimited.

Barron, A. E. & Orwig, G. W. (1995). *New Technologies for Education: A Beginner's Guide* (Second Edition). Englewood, CO: Libraries Unlimited.

Basch, R. (1993). *Secrets of the super searchers.* Wilton, CT: Eight Bit Books.

Berenfeld, B. (1993). A moment of glory in San Antonio. *Hands On!,* 16(3).

Caputo, A. (1994). Seven secrets of searching: How and when to choose online. *MultiMedia Schools,* 1(1), 29–33.

Eisenberg, M. and Berkowitz, R. (1990). *Information problem-solving: The big six skills approach to library and information skills instruction.* Norwood, NJ: Abblex Publishing.

Elmer-DeWitt, P. (1995). Welcome to cyberspace. *Time,* 145(12), 4–11.

McKenzie, J. (1995). Direct Connect: Beforenet and afternet. *MultiMedia Schools,* 2(3), 6–8.

Society

Digital Florida: Multimedia Resources for Teachers and Students (AECT)

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Key Words: **multimedia, Internet, World Wide Web, staff development, student-centered instruction, community-based education**

Digital Florida is a site on the World Wide Web where students and teachers can locate and retrieve multimedia resources about the Sunshine State. In addition, Digital Florida provides a place where presentations and multimedia reports created using these materials can be published and shared with others. The site was established by the Florida Department of Education and is maintained by the Instructional Technology Resource Center (ITRC) at the University of Central Florida and can be accessed through its web site (*http://www.itrc.ucf.edu/*). Using resources from the Florida Department of Commerce, the Florida Archive, and the Florida Geographic Alliance to establish the site. Teams of teachers were used to work with these groups to identify potential resources for the site.

Digital Florida resources include sounds, movies, and images about Florida, its history, geography, commerce, landmarks, people, people, plants, animals, attractions, and more. The database is organized through a table of contents, and its contents may be searched from the web site.

The site was announced at the 1996 Florida Educational Technology Conference, and information about Digital Florida resources was included on the 1996 FETC CD-ROM. It is anticipated that students and teachers will work together with community members to identify appropriate resources within the area and to submit them to the project. By involving the community, schools can use Digital Florida to demonstrate the importance of the Internet and its resources as well as the benefits of connectivity for all students.

The ITRC coordinates members of the Florida TechTeam who work regionally with interested teachers and students who are willing to work with community agencies including tourist bureaus, chambers of commerce, and local businesses and industry to make the site familiar and to help the number of available resources grow. This activity provides an opportunity for teachers to be advocates for technology in the community, and positions teachers as leaders and professionals interested in the community, their students and technology.

Materials may be submitted to Digital Florida in any format: disk files, audio recordings, videotape, photographs, slides, etc. They are digitized using the resources of the Instructional Technology Resource Center and UCFUs Digital Image Processing Laboratory. Digital resources are cataloged, indexed, and placed on the web site.

Workshops for educators held at the UCF Multimedia Training, Research, and Development Center help teachers learn to access the resources through FIRN (the state information resource network which provides free Internet access to full-time public school educators); to use Digital Florida resources with a variety of software programs including *PowerPoint, HyperStudio* and others, as well as on their own web pages; to assist students in understanding the ethical use of Internet materials; and to integrate Digital Florida resources into the curriculum.

Digital Florida provides a link to SUNLINK on the World Wide Web, a growing union database indexing over eight million library media resources in over 1000 Florida public schools. A separate state-funded project housed at the University of Central Florida, SUNLINK is available on CD-ROM and, most recently, through the World Wide Web. In either case, SUNLINK can be searched by author, title, subject, language, format, keyword, and/or location. Items not contained in the school collection can be borrowed through interlibrary loan from one media center to another. A protocol for resource sharing has been established.

This session will describe Digital Florida, its beginnings, and its use. Technical information and lessons learned will be discussed for those interested in similar Internet projects.

Project
Student Teachers' Multimedia Portfolios

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Key Words: portfolio, pre-service, teacher, multimedia, resume, HyperStudio, student

Concept

Student portfolios have made an impact on how teachers as well as students assess student learning. Pre-service teachers at Hillcrest Professional Development School play the role of both teacher and student. The Hillcrest PDS, likewise, has a dual function. One part is to serve as an extension of the Baylor University cam pus and train professional teachers. The other, as a public magnet in the Waco Public Schools, to teach students to be lifelong learners. The multimedia portfolio helps achieve both objectives. Pre-service teachers can use it as a tool for reflection and evaluation during their year-long student teaching assignment. Later it is an important instrument that can showcase skills and professional growth to potential employers.

First Year

The author is assigned full time to the Hillcrest Professional Development School as a Technology Facilitator by the Waco Public Schools. Additionally, he serves as an adjunct faculty member in the School of Education at Baylor. Another Baylor faculty member, Rick Strot, is assigned full time to Hillcrest PDS as a Clinical Professor. The Technology Facilitator and the Clinical Professor met with the student teachers to explain the possibility of creating a multimedia portfolio, discuss electronic options, and to determine student interest. Initially, all of the pre-service teachers expressed an interest in creating a multimedia portfolio. Some were more interested in the product as a reflective tool, but most valued the possibility of using it as a résumé.

The group weighed the advantages and disadvantages of two software packages with which they were familiar: *HyperStudio* and *The Grady Profile*. *HyperStudio* was selected because the students knew more about the software, felt it would be easier to create their product, and that it would be easier for the reviewer. During the next few months, five of the fourteen student teachers showed enough interest to begin working. The team met again to discuss strategies, technological capabilities, and to develop a framework. The students were encouraged to develop a textual outline and storyboard to discuss with the technology facilitator. A pre-Kindergarten student teacher, who was particularly motivated by an early job interview, began working quickly. Another early childhood student teacher joined her and the two completed the majority of their multimedia résumés in about three weeks. Both products looked very similar, as they had copied each other's structure. The products included traditional textual résumé material as well as graphics. The graphics consisted of scanned and digital photographs: school symbols scanned from print material and Baylor photographs from the campus server on the World Wide Web. Sound files were linked to some of the photographs.

These clips included the early childhood students describing their work in the photographs as well as audio references. A third teacher started her multimedia portfolio shortly after the first two finished. Her multimedia reflection on her year of student teaching in a multi-age Kindergarten class was similar, as she also used the shell that her pioneer colleagues had created.

The big difference with this product was that the student teacher included scanned samples of student work. The items included handwriting, math, and art. The reactions of the potential employers during the interview process were quite different. They ranged from not having any interest in looking at the multimedia portfolio or keeping the disks to seemingly having more interest in the PowerBook and *HyperStudio* than the candidate. Fortunately, all three obtained jobs in schools in which they were interested. In fact, two of them team teach in south Texas. None of the other student teachers completed their multimedia products. All of them did create a "paper notebook" anthology of their work. The three students who did complete the electronic version were given credit for the print version on their student teaching proficiencies. Overall, the first year was successful. Three students created final products, while everyone involved, including the university team learned more about *HyperStudio* and creating multimedia products. Follow-up interviews with the students that created the resumes felt that they helped them to get better jobs. One was even asked if she would consider working as the district's technology coordinator! Finally, this process was shared by invitation at the annual *HyperStudio* Festival in July, 1995.

Second Year

The second year got off to a much faster start. The first day that the student teachers were on campus, the team showed them the multimedia resumes from the previous year. All eleven candidates showed initial interest. Changes incorporated for this year are four-fold. First, more of the technology will be exploited. Student teachers are encouraged to use *QuickTime* video clips in their final products. Second, much larger amounts of data may be used. One reason for this is because Hillcrest PDS now has access to a CD-ROM recorder. Students also have the option to export their product to video tape. The third change in this second year is that students are encouraged to use more of their personality and teaching styles in their multimedia résumé. This should result in more of the products "feeling" like the individual authors. Finally, the Baylor team will conduct more extensive interviews at the end of the process. Not only will the student teachers be questioned, but also, with permission, the potential employers will be interviewed. The goal of these follow-up questions is to determine reactions to the multimedia portfolio and to find out what happened to the media after it was offered to the interviewer. Hillcrest PDS and Baylor University hope to continue to improve on this process. Our goal for the third year will be to grow the résumé aspect of the portfolio while concentrating most of the team's efforts on the reflections.

Focus
From Access to Application: Bringing the Internet into the Science and Mathematics Classroom

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Key Words: **Internet, standards, science, math, professional development**

Mission

The mission of *From Access to Application* is to develop a model professional development program for upper elementary grades that promotes teachers' competence and confidence in using the facilities and resources of the Internet in standards-based science and mathematics teaching and learning.

Goals, Objectives, and Outcomes

The **goals** of *From Access to Application* are:

- To enable teachers to use the Internet and its resources as a tool for inquiry-based learning in which students become active participants in their own education;
- To use the action research methodology of professional development, providing teachers the opportunity to plan, implement, observe, and reflect on their own professional development; and
- To develop an interactive electronic laboratory, a "co-laboratory," with the National Education Supercomputer Program (NESP) at the US Department of Energy's Lawrence Livermore National Laboratory in order to improve the classroom applications of the NESP.

From Access to Application's **objectives** are:

- To develop a standards-based, hands-on professional development program in the use of the Internet for science and mathematics education;

- To engage elementary teachers in the design and development of the program, both in order to develop a practical, pragmatic professional development curriculum and also to model the behavior of teachers contributing to their own professional development;
- To implement the program in two phases in order to observe and document the effort required to replicate and scale-up the program;
- To measure, assess, evaluate, and document the successes and failures of the program and use these results in a continuous improvement process to revise and improve the program as it is implemented; and
- To disseminate the results to local, state, regional, and national audiences.

The expected **outcomes** of *From Access to Application* are:

- The development and use of a replicable and scalable staff development model that efficiently and effectively develops elementary teachers' competence and confidence in using the Internet for science and mathematics teaching and learning;
- Approximately 80 highly-skilled elementary teachers using the Internet for science and mathematics instruction, who are also prepared to train and support peers throughout the state;
- The development and use of new or refined NESP teaching tools; and
- The development and use of new instructional units that validate the use of the Internet for teaching and learning.

Challenges and Strategies

The A2A [short for *From Access to Application*] project staff and teachers and principals from Pilot and Tier 2 schools have identified several challenges to be faced in accomplishing our goals. These challenges and the strategies we have adopted to address them are as follows.

Challenges we face:

- There is a need to validate the Internet's resources and facilities for teaching and learning, especially in K–12 education.
- We need to acknowledge the desire among teachers and school administrators (and the expectations of parents) for teachers to receive effective professional development while minimizing their absence from the classroom.
- There is a need to overcome isolation and foster collegial, shared responsibility for professional growth.

Strategies we've adopted:

- We will use the action research model—which encourages teachers to study the results of their own practice through a cycle of planning, acting, observing, and reflecting—to develop new skills, tools, and applications.
- We will train teachers in peer coaching strategies so they can coach and help each other with on-site implementation of new knowledge and skills.
- We will use the electronic mail and other communication tools of the Internet to provide technical and professional development support in real time, that is, at the time that the teachers need it and ask for it.

Components of the Model

The A2A model comprises activities conducted both on-site and off-site over the course of a full year, including the summer, totaling 15 days. The model is broken down into three phases.

Phase	Description
Pre-Institute	A series of sessions held on-site focusing on building teachers' skills using the Internet for e-mail, listservs, newsgroups, Gopher, the World Wide Web, etc., and providing teachers with information about the national science and mathematics standards for teaching
The Institute	An in-depth experience focusing on building teachers' confidence and competence using the facilities and resources of the Internet for professional development and classroom application through practice and collaboration with their colleagues
Post-Institute	A series of follow-up sessions focusing on reflective practice, teacher as a producer of knowledge about teaching, and advanced skills for publishing information on the Internet

Evaluation

The A2A model is using the following definition of skill levels to help the teacher participants self-assess their competence and confidence in using the Internet and NESP tools.

Internet Skill Levels

Level	Description
1	E-mail one-to-one
2	E-mail one-to-many (listservs, news groups)
3	Retrieve information from Gopher & WWW and use NESP tools
4	Use all of the above w/students
5	Publish information on Gopher & WWW

A teacher may enter the model at any skill level and will likely operate at different levels at different times and in differing situations. The Concerns Based Adoption Model (CBAM) is used to track teachers' movement through the skill levels. Progress in individual teacher participant's use of the Internet are documented through interview and assessment using the Stages of Concern Questionnaire (SOCQ), a 35-item paper and pencil measure that typically requires 10–15 minutes to complete.

Panel

Computing, Diversity and Community: Attracting Women and Minorities

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Key Words: **gender issues, curriculum, computer science, classroom climate**

The University of Wisconsin Women and Science program, funded by an eight-semester long National Science Foundation grant, is designed to reverse female and minority attrition from the sciences at a point where it is most acute: the introductory courses in the undergraduate science curriculum. This program seeks to reach students, who, though qualified to do science, choose another major. Since the innovations known to be effective with women and people of color have also shown to attract other students, the project should gradually increase the total number of students majoring in the sciences. The program seeks to revitalize introductory curricula and increase female and minority participation in science by:

1. increasing faculty expertise in gender and science scholarship and pedagogy,
2. providing role models of professional women scientists,
3. improving classroom or campus climate,
4. creating "science communities" that will promote effective learning.

We will discuss the work done specifically in Computing at the Stevens Point campus of the University of Wisconsin. This panel brings together the various members of this program at Stevens Point: the Distinguished Visiting Professor (Danielle Bernstein), resident Faculty Fellows (Gerald Gau, James Gifford, Sandra Madison), campus coordinator (Robert Morris) and department head (Bill Wresch).

We will describe the collaboration between a Distinguished Visiting Professor and resident Faculty Fellows to build expertise on gender and science issues that will spread throughout the institution. The panel will focus on the improvements that took place in the content, classroom climate and laboratory climate in the first course in the CIS major as the result of this collaboration. Anticipated spin-off activities will be described. Student reaction will also be analyzed.

Project
Setting up and Running a Classroom Macintosh Web Server

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Key Words: **Internet, World Wide Web, web server, Macintosh, publishing, middle years**

Are you looking to provide more meaningful Internet experiences for your students? Are you tired of just taking from the Internet and are ready to give something back? Do you see a gap of information on the Internet that only you and your class can fill? Do you want your student's projects, papers, and reports to have the same number of subscribers as *Time* Magazine? If you answered yes to any or all of these questions then this session is for you!

Learn how a middle years classroom teacher transformed her class from "Web Surfers" to "Web Publishers." This session will chronicle the trials and tribulations of a year long project to develop a unique presence on the Web by a class of eighth and ninth grade students and their teacher.

Ideally participants should have or are planning to get a direct connection to the Internet. The project itself is Macintosh-based, but the concepts covered could apply to any platform of computer. The presenters will endeavor to outline, as much as possible, alternative ways of completing the project using other hardware and software combinations.

The session will cover the presenter's experiences in connecting a school lab of Macintosh computers to the Internet. Then follow them as they introduce students to the Internet, and how it works. Finally see the steps taken to have students move out onto the Web as publishers. The project particulars will be broken down into individual steps in order to provide participants a "cook-book" of ideas for conducting a similar project.

The session will concentrate on three areas: Internet set up and configuration, school based hardware and software, and student activities. The necessary Internet background configuration and set-up required to successfully run an Internet server will be discussed in layman's language, and hopefully de-mystify this process. An overview of school's hardware and software configurations and set-up will also be detailed. The project centers around a Macintosh *WebStar* server from StarNine Technologies, connected to the Internet via an ISDN connection. Supporting hardware and software used in the project will also be explained. Specific attention will be given to the setting up and running of the *WebStar* server, although other servers could also be used.

Sample student activities and assignments will be distributed so participants can see the progression of student skills necessary to complete the project. A student journal will also provide insights into the student's perspective of the project. Finally participants will be taken through a tour of the project's server and the online pages available as of the conference. It is expected the server will include some or all of the following student-produced and researched topics: Careers: "What Will I Be?," Multiple Intelligences: "7 Kinds of Smart," and "A Sustainable Development Project" which will include student-authored *HyperCard* stacks. Details will be given as to the nature of student direction required to complete these topics and student efforts in publishing these pages.

Society

The Road Ahead: The First Year (ISTE)

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Key Words: **professional development, collaboration, mentoring, Road Ahead, NFIE, ISTE, Microsoft**

In 1995, the National Foundation for the Improvement of Education called for proposals from schools around the United States to develop programs to accomplish the following goals:

- design and implement collaborative, student-centered activities that demonstrate how teaching and learning are facilitated by multimedia and telecommunications technologies.

- foster students' ability and confidence to use information technologies in powerful ways in both formal and informal settings.
- assess the effects of participation in technology-infused learning environments on students, teachers and other educators, and staff from community-based organizations.
- share program findings, replicate successful practices, and offer policy recommendations to promote the widespread provision and use of multimedia and telecommunications technologies for effective student learning.

The $3 million program, *The Road Ahead,* was funded by proceeds from the book of the same name by Microsoft founder and CEO Bill Gates. NFIE awarded grants of $30,000 each to 22 school/community partnerships in 15 states, out of a total of 343 applicants. The program runs through the 1995/96 and 1996/97 school years.

The International Society for Technology in Education (ISTE) is working with NFIE to evaluate this ambitious program. Although student outcome data from the first school year will not be available until mid-summer 1996, participation in the planning process, a week-long program-wide workshop, and online discussions allow us to make certain observations about major elements of *The Road Ahead.*

The Proposal Process

Acceptance of a proposal was only the beginning of the process. The 22 selected teams revised their plans with direct advice and training from NFIE, beginning with an intense week-long workshop in Washington, DC, and continuing with long-distance input from NFIE staff and teachers assigned as mentors to the sites. Full implementation did not begin until January, 1996. In the 22 revised proposals, definition of goals and assessment procedures was much sharper, and the NFIE model of an actively supported planning process seems to have been effective.

Collaboration

A typical site in *The Road Ahead* emphasizes classroom activities that integrate technology, such as conducting online research. The after-school programs typically offer additional computer access to students or community members. The community agencies often participate both as providers of information (e.g., students interviewing senior citizens about community history) and as a venue in which students provide services to the community (e.g., students teaching senior citizen to use public library computers). In many cases, teams formed in response to the request for proposals. School-focused participants, which included teachers, administrators, ISTE, and NFIE, had to learn about the needs and concerns of the community agencies.

Professional Development

One of the ways NFIE supports *The Road Ahead* sites is through a series of multi-day capacity-building Workshops conducted in fall 1995, summer 1996, and summer 1997. All participants in the program are brought together at one site for lectures, technical training, and small group planning sessions. The first of these, in September 1995 in Washington, DC, concentrated on the revision of the original proposals. Addition workshops are scheduled for July 1996 and summer 1997.

Some participants were surprised by the intense working sessions required at the first workshop. Nevertheless, two thirds of participants, mentors and team members, reported high levels of learning and satisfaction, with narrowing the goals of the project being one of the most frequently listed achievements. The group workshop approach seemed to be an effective technique for revising a major planning document in a short period of time.

NFIE also supports sites by providing each with a veteran mentor teacher. In most cases, the mentor does not live in the same part of the country as the sites, but is matched with a site on the basis of experience with similar grade levels, subject matter, or activities. Mentors for *The Road Ahead* were previous NFIE grantees experienced with educational technology. Mentors initially assisted with the proposal revision, facilitating brainstorming sessions at the fall capacity-building Workshop, later critiquing the rewrites online, and occasionally serving as advocates for site concerns before NFIE. Mentors are now moving into a different role of supporting ongoing programs. One concern of the mentors is their remoteness from their sites (there is no provision in the program for regular site visits). This is a unique aspect of the NFIE approach to mentoring, and ISTE will be evaluating the workshops and telecommunications components partly in light of their ability to facilitate mentoring at a distance.

Telecommunications

Because of the dispersed nature of the sites and the infrequent program-wide workshops, telecommunications is the only means for sites, mentors, and the NFIE staff to maintain regular timely correspondence. *The Road Ahead* provides e-mail and discussion areas through America Online, as well as an Internet-based mentor discussion list.

Use of the online services was greatest when there were particular issues to resolve, such as the selection and purchase of computers for the sites, and was greatest among participants who were online at the beginning of the project. (Technical problems getting online were a major challenge for some sites.) These use patterns seem consistent with other research indicating that access and purpose are necessary to sustain an online community.

A lack of privacy—termed the "fishbowl" effect by the mentors—tended to drive certain kinds of communications off of the networks. Thus certain key planning activities, such as questions about budgets and evaluation, were often handled by phone calls or personal e-mail, rather than appearing on the general mail lists or online forums. ISTE will be watching for changing patterns in online use as sites and mentors—now with broader e-mail access and a longer working relationship—undertake program revisions going into the second school year.

Project

The Economically Disadvantaged and Home Internet Use

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Key Words: Internet, underrepresented, parents, telecommunications, home-school connection, life-long learning, self-directed learning

The primary goal of this project was to study how underrepresented families made use of home Internet access and of what value it was to them. Promising projections of the benefits afforded by Information Superhighway access, especially for low-income, racially or ethnically diverse individuals and families, abound in both the popular press and political arena. "It is the poor and economically disadvantaged, more than anyone who should have access to the Internet" (Berger, 1995, p. 38); they are among those with the most to gain from the timely realization of an information infrastructure capable of delivering online communication, entertainment, and information services directly into the home, according to US Department of Education special advisor on technology Linda Roberts. Vice President Al Gore envisions the Information Superhighway as a dynamic force for social good, improving communication, education, medical care, and political participation. Indeed the Clinton administration considers universal access to the Internet and its potential successors known as the National Information Infrastructure (NII) as "the most viable route to ending the differences between information haves and have-nots" (Piller, 1994 p. 64). In this scenario an "individuals' economic and social well-being depends on the ability to access, accumulate, and assimilate information [and] while a standard phone line can be an individual's pathway to the riches of the information age, a personal computer and modem are rapidly becoming the keys to the vault" (NTIA, 1995 p.1).

Such rhetoric about the ultimate impact of the Information Superhighway on the underrepresented has, until recently, been grounded only in speculation and conjecture. This presentation will provide research based evidence supporting these encouraging conjectures. Findings are the result of a qualitative dissertation study of home Internet use by low-income families in an urban area of east central Florida. This study is one component of a larger Internet research agenda established by Dr. Michael Gallo at Florida Institute of Technology in 1994. Data for this study were collected on a sample of six families. By studying a small group of families in-depth we accumulated information about the patterns of use, benefits, and problems associated with home Internet access.

The Underserved Families Internet Research Project, which focused on the traditionally underserved, included minorities, families from low socioeconomic areas, and those with limited English proficiency. These families were loaned a computer and high-speed modem, were provided free PPP Internet access through Florida Institute of Technology, and received basic computer skills training along with a variety of technical support resources. Participating parents also were taught how to use the Internet to communicate electronically using e-mail, resource searching strategies, and how to acquire information from the Internet.

Our findings suggest that home computer and home Internet access can help change the image of underserved parents about their role in education, raise the awareness of underserved parents about global networking, and provide underserved parents with practical, first-hand knowledge about technology, which gives them the technology-based experience prerequisite to becoming technologically literate. It was also discovered that underserved parents developed proficiency in using telecommunications hardware and software, and used local and global resources to facilitate learning for themselves and their children. Parents participating in this study found mastery of computer technology empowering, and used their home Internet access to improve their economic, educational, and medical circumstances.

While conducting this study, we identified the following: (1) strategies, activities, and materials that can be used to encourage entry into technology by the underserved; (2) barriers to access; and (3) the support services required for this group's continued participation.

School and research personnel volunteered their time to implement this project. Donations of equipment and technical support resources were made by local businesses and community organizations. Through NSF support, we are now examining the potential benefits of extending this project into the community at-large by setting up an urban community center to serve as an Internet point of presence for other members of the underserved community.

Project
NYC Bilingual Multicultural Institute's Successful Focus on Technology

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Key Words: **bilingual, teacher training, integration, ESL, multicultural, NYC**

The Division of Bilingual Education of New York City's Board of Education is beginning its third year of implementing a state-funded project that uses technology—telecommunications, instructional software, and multimedia—to link together four main components in the areas of bilingual, multicultural and ESL education:

- Professional development
- Research and higher education
- Parental and community involvement

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- Multimedia curriculum development and resources

The Bilingual Multicultural Institute (BMI) project's mission is to respond effectively to educational challenges posed by the diverse bilingual and multicultural student populations in the New York City public schools.

One of the challenges identified early in the project was technological equity for bilingual students and teachers. Therefore, the technology goals include staff development in the area of bilingual education instructional software, telecommunications, and multimedia curriculum development. Familiarizing and training present and future bilingual teachers in the use computer and other technologies in the classroom has become a priority. Parents have also been included in learning the benefits of technology for their bilingual children.

A computer-network resource center was established the first year at the Division of Bilingual Education. Classes were set up for a start-up group of 24 teachers and 15 administrators to learn the basics of electronic mail and word-processing. Next, teachers and school principals were trained on the use of multimedia tools so that they could create multimedia projects with their students. This was implemented initially in two elementary schools by providing computers and software for the trained teachers' use in their bilingual classrooms. Teachers were also trained on the use of the NYC schools wide area network (NYCENET). This spring, the resource center was opened for all teachers to preview bilingual and ESL software, and was booked solid throughout the spring and summer. This year it is expanding its services, including Saturday sessions, influenced by a research survey conducted last year among participating teachers, parents and students.

The first annual one-day technology institute for bilingual and ESL educators in NYC was held last May in partnership with a bilingual institution of higher education. Teachers who use technology in exemplary bilingual and ESL programs presented their project concepts and student results. Also, a broad sampling of software programs were made available for hands-on testing in as many languages as possible, including ESL. Training for both parents and teachers continued via NYC-run parent and teacher institutes at educational conferences.

The Bilingual Multicultural Institute's success has sparked interest in setting up and coordinating similar efforts across the state, and the pilot schools are being asked to participate in a world-wide Spanish/English network by a major corporation.

Focus

Internet Staff Development: An Innovative Twist

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Key Words: **professional development, Internet, student leadership teacher training, K–12**

The Boulder Valley School District (BVSD) and the University of Colorado at Boulder have been engaged in a collaborative partnership since 1992 to deploy Internet connectivity, pursue district-wide staff development, explore the application of the

Internet technology in the curriculum, and develop a community network. This paper focuses on the professional development aspects of the Boulder Valley Internet Project.

In 1992 the Internet staff development effort began a core group of 26 teachers, representing kindergarten through grade 12 and many subject areas. After two years of training and practice, each member of the core group carried out the trainer of trainer models by doing staff development for eight additional colleagues. The model continues as we strive to place 2–6 "trainers" in each school building. Although it has been successful thus far, the trainer of trainers program cannot meet all the challenges of educating several thousand staff members with varied schedules and learning styles. Described below are two additional projects we have initiated to create a more robust professional development program.

This first initiative, Students As Internet Leaders (SAIL), supports continuous development of a cadre of Boulder Valley students who choose to serve their educational community as Internet learning partners to teachers, peer mentors and eventually independent Internet mentors to district teachers. Student participation is voluntary at both the individual and school level.

The SAIL program enables students to choose from several different "stations." Although the stations are not completely hierarchical, they do support a progressive model of students moving from less responsibility and knowledge of the Internet to positions which require Internet expertise and school or district leadership.

The first station, Partners in Learning, is designed to support teams of students and teachers exploring together and experiencing partnered learning. A constant endeavor of the Internet project has been on-going Internet seminars offered to the entire district staff. This series of classes is offered after school, throughout the year and is taught by teachers. (To see the class schedule, check http://bvsd.k12.co.us/docs/classes.html.) Fifth grade students and up may enter the SAIL program by attending one of the Internet seminar series programs with a teacher. Through this experience students get a complete introduction to the Internet and the basic tools. Students are exposed to a good model for Internet training and can build a foundation for an ongoing mentoring relationship with a teacher.

Station two of the program involves peer mentoring. The students from station one who are recommended by their teachers to proceed in the program are asked to attend a workshop in which they explore different ways to help their peers learn to use the Internet and how an instructive, collaborative partnership might work. Role playing which hammers home proper use of the network is a part of this workshop.

Station three, participation on the school orientation team, is designed to give students a leadership role as well as solve a local school dilemma. As all fifty of our district schools come online between January 1995 and January, 1997, there is a mad rush by students to get Internet accounts. Properly educating this great mass of hungry students is a chore. This task can be approached systematically if knowledgeable students are recruited to work with the "newbies." The student members of the school orientation team, under the guidance of an adult, hold after-school new users' seminars for interested students.

In the fourth station of the SAIL initiative, students take on a role as a teacher Internet instructor (TII). We have not formally reached this state, but the idea is that students will become personal trainers and resource people to individual teachers who prefer to learn technology in a one-on-one situation. The students will provide teachers with easy-to-access support, enabling them to continue with their endeavors rather than aborting their efforts because they get hung up on technical problems.

Perhaps the ultimate station of the student leadership project is participation in the district guide corps. This group was put in place in 1993 to serve as an online help

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resource. Currently, ten students share the responsibility of answering all of the questions that are sent to the local help queue. These questions come from any BVSD Internet user and cover a wide range of issues from dialing with a modem to resource questions.

A second new initiative in Boulder Valley's staff development process is an attempt to address the question: How do we enable teachers who do not know how to use the Internet (or initially might be too intimidated to learn) to apply Internet resources to the curriculum? The budding project which we have initiated to address this issue is the Internet Explorers Guild.

The objective of this program is to assist teachers and students in using the Internet as a research tool by providing them with lists of resources tailored to their needs. Student Explorer teams will take topics submitted by teachers, search the network for pertinent resources, and build a world wide web home page composed of all of the resources. After teacher review and any necessary revision, the page will be at the disposal of the teacher, all of his or her students, as well as anyone else using the world wide web through BVSD's home page.

Although both the SAIL initiative and the Internet Explorers Guild are in their infancy, we hope to see them blossom into systemic district-wide initiatives. The lessons we continue to learn will be forthcoming.

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Project
Teaching, Learning and the One-Minute QuickTime Movie

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Key Words: **multimedia, curriculum, digital images, digital audio, QuickTime, HyperStudio, Adobe Premiere**

This session will demonstrate recent multimedia classroom projects that use a "One-Minute Movie" strategy to focus attention on content rather than technique, diminish the likelihood of serious technical problems, and improve the quality of learning products produced by students. While it is becoming easier to add video and audio multimedia enhancements to all types of school projects, the demands made by multimedia applications on commonly available computer resources place limitations on the nature of student products and often tend to shift the classroom focus away from course content to technical considerations. Through the application of thematic webbing, storyboarding and focused use of images, sounds and graphics it is possible to work with digital multimedia materials in a time bounded production style that encourages the editing and construction of content rich learning products. The session will examine several recent classroom curriculum projects that were thematically planned and conducted using three types of multimedia enhancement—digitized pictures, *QuickTime* movie clips, and digitized sound—in both Hypermedia and Movie environments.

Project TUG—It's Elementary!

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Key Words: **elementary, multimedia, Kid Pix Studio, peer tutors**

Students in Pearson Elementary School have the opportunity to learn and apply multimedia reporting and peer tutoring skills through TUG (Technology User Groups). The sessions began in the fall of 1994. Groups of ten students from the third and fourth grades met weekly after school for six week sessions during the first year. The first groups learned multimedia reporting using *Kid Pix Studio* software. Their finished reports were exported to videotape for display at several school-community events.

In another session students, teamed in grade level groups, used *HyperStudio* to create interactive reports linked to classroom topics. Each student developed one concept of the theme. All the sections were later connected to a common "home card." These projects were shared in classrooms and with parents at a school event.

In 1995–96, Tiny TUG was created to involve first and second grade students during the school day. The initial group of first graders were selected via recommendation by their previous kindergarten teacher. Later groups were selected via recommendation of their current teacher, with no required criteria. We asked each student to create several slides related to a classroom theme. All their slides were then combined into large slide shows. Finished slide shows were presented at cross-age school meetings and on parent visitation days.

TUG for third and fourth grade students was continued as well. Groups of eight could volunteer to attend for six days during their noon recess. While creating slide shows on their choice of topic, they practiced software techniques, concept development and sequencing skills.

Our method was to demonstrate basic operation of the software and explain project guidelines and expectations to students. They then created their own products, receiving assistance from advisors when they asked or when a difficulty was observed.

For the younger students, peer helpers from fourth grade gave additional support to the two teachers. This was especially helpful when pre-readers needed to save files in particular folders. These helpers were selected from previous TUG groups. Young students seemed to gain confidence with computer techniques when they had the opportunity to observe their peers' skill. The tutors grew in self-esteem, responsibility and presentation skills. Tiny TUG members were, in turn, asked to assist their classmates in classroom computer use. We find having student helpers available has aided and encouraged technology use and interest in the classroom.

Results of this project have been very positive. *Kid Pix Studio* has become the primary interest of students when they are allowed an option in reporting style. TUG students have created a number of multimedia reports on classroom study topics. There is a growing interest in learning *HyperStudio*'s possibilities for presenting webbed and branched information, and in mastering its special effects potential. Tiny TUG students initially pooled their work to create alphabet and math slide shows. Later sessions built flip book style animations, with a slight change on each successive slide. By mid-year students had moved into more complex projects using *Stampimator*, *Moopies*, and *Puppets*.

Video shots were taken, by a student, of the learning and production process. This tape was edited with assistance from our local public access television station for presentation to the Board of Education and was broadcast on the public access channel. Through this project students, staff and community members have gained an awareness and appreciation of the usefulness and application of multimedia technology in education.

Focus

Blueprint for Learning: The Technology Connection

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Key Words: **engaged learning, higher level thinking skills, NCREL, architect, collaboration**

Technology planning is an ongoing process that continually needs review and refinement. As Addison Elementary School District #4 began to evaluate the fourth year of its plan, it was determined that since there was a solid "foundation" for technology, it was time to "build"! To plan for the future, the committee felt that there needed to be a vision of what the students will need, how the learning environment will be structured and what the role of the teacher would be within this environment. An appropriate "blueprint for learning" is one that looks first at student learning and then at technology to support that environment.

After reviewing current research, it was determined that the study published by the North Central Regional Educational Laboratory (NCREL) had the piece we were looking for. The NCREL study (1994) shows there are several factors common to effective classrooms and learning environments. From this study, the committee gleaned major indicators related to student learning. These included a learning environment that is interactive and generative. It offers students an opportunity to be engaged in collaborative and active learning that includes the use of higher order thinking skills. The learning tasks of the classroom needed to be structured to be authentic, challenging and integrative.

It was further recommended by the committee that the classrooms should be structured as a highly engaged learning environment with utilization of high technology by the students.

As students progress through a system that fosters the type of learning environment described above, they become more responsible for their learning. They are strategic in approaching learning and they use problem solving skills in many contexts. They develop skills in working with others and are energized by their learning.

In a metaphorical sense, the teacher is the architect of the structured learning environment. The teacher designs and manipulates activities that engage students in learning. The teacher, like the student, is a creative problem solver. S/he strives to continually understand what students need and bring new ideas to the learning environment. The teacher is the architect of the learning environment. Technology is the tool.

Project
Electronic Publishing in Teaching and Learning

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Key Words: **electronic publishing, electronic journal, hypermedia**

There are currently more than 450 electronic journals and newsletters residing on the Internet. Many of those are scholarly journals that are to varying degrees peer reviewed. There are others that are in a transition phase between the shifting information platforms that Negroponte (1995) likes to call "atoms to bits," or from the tangible print-on-paper to an electronic format, whether that be CD-ROM, diskette, or online service. Some of these journals include the *Byrn Mawr Classical Review*, *Psycoloquy*, *Protein Science*, and *Surfaces*. A quick trip through gopher space or the World Wide Web will turn up limited, searchable editions of popular periodicals such as *Wired* magazine, *The Chronicle of Higher Education*, and many others.

The purpose of this project was not simply to discover what is currently being done in electronic publishing, but more an attempt to speculate on what scholarly journals could be like in the not too distant future. The view taken in this project is inconsistent with the current trend of information providers such as television networks, cable companies, and phone companies to simply offer more, better, faster versions of the same thing. While there are many issues, such as copyright, that need to be clarified before electronic journals become part of academic life, preliminary research into how this new medium can be used more effectively needs to be explored.

While the power of the electronic journal is not so much the amount of information that can be included in the edition (although a CD-ROM journal can hold 5 billion bits of information). The main advantage of the electronic form lies in the context in which the information is obtained. The electronic journal issue used in this project attempted to incorporate hypertext and hypermedia enhancements specifically designed for scholarly reading and research. It may be thought of as in information organizer or "study guide" for researchers. This has been previously referred to as "cooperative text" when discussing similar materials created for students. The electronic journal could be read on screen in a linear, page-by-page fashion just the same as its print-on-paper counterpart, but with several important hypertext enhancements available to the reader.

These included:

1. Reference citations in text that were linked to full abstracts of the article.
2. A dictionary of terms for words or phrases that the author or editor felt needed specific clarification in terms of the context in which the words were used in the article.
3. References for cognitive links within a single article through a search feature for specific words or phrases.
4. References for cognitive links within accompanying articles in the electronic edition.
5. References for cognitive links created by the editor within a single article or accompanying articles.
6. An electronic note-pasting system providing editors the opportunity to add electronic "sticky notes" to any section of the article without actually altering the original manuscript.
7. Thumbnail page icons and an outline-style index system.

The authoring system selected for this experimental electronic journal was *Adobe Acrobat*. The content consisted of several manuscripts that had been selected for a thematic issue of a nationally recognized scholarly journal focusing on technology use in education. Each manuscript was first converted to the *Acrobat* portable document format and then modified with the enhancements mentioned above. Cognitive links within and between articles were created based on repeated specific words and phrases, content similarity, student population, and research methodology.

The audience for this project was a group of graduate students enrolled in a seminar class focusing on the use of technology in educational settings. The participants were given a copy of the journal on disk and were asked to study the five articles included in the issue. User response to the electronic journal was collected through narrative reaction papers from the students along with a Likert-scale instrument to collect reactions to specific questions.

Project
The Electronic Foreign Language Project by Virtual Environments for Cross-Cultural Communication

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Key Words: **Webware collaborative design, multimedia, instructional Webware evaluation, second/first language communication skills**

Goals and Scope

At a time where developments in telecommunications are providing an opportunity for a better understanding among the "world's citizens," one should realize that the key for such understanding lies not in how fast and how much but in what and how well those citizens may communicate.

The main goal of the Electronic Foreign Language Writing Project is to enhance the writing skills of L2 and L1 students through the use of electronic networking. The project also seeks to: a) develop students' comprehension skills[1] and ability to recognize what is valuable within the massive and often indiscriminated information provided by current electronic sources; b) to bridge the gap between the L1 and the L2 curricula, and the gap between the foreign language and the foreign literature curricula; and c) to infuse multiculturalism into the foreign language curriculum.

The project will affect students of different languages (English, French and Spanish), with different language levels, in different instructional situations, and at different educational institutions. First, an online World Wide Web (WWW) program will be used eclectically for activities in the languages taught at the institutions participating in the project. Second, the program will be used by beginning, intermediate and advanced language students. Third, students will work with the program on a stand-alone basis or within the framework of a classroom activity or assignment. And fourth, the project will reach students in an American and in two European (Poitiers (France), Mallorca (Spain)) universities.

Empirical Grounds

SLA Research in Writing

SLA research is beginning to provide a picture of how learners develop their writing skills and the role of instruction in this process (Schecter and Harklau, 1992). As Gass and Magnan (1993) observe, "We now see writing as mainly a recursive process with positive links to ability to write in L1. We see instruction as most beneficial when it helps students understand and become fully involved in the recursive process of writing. The value of instructor feedback is still undetermined, with indications that important factors are the amount students write and their degree of involvement in the revision process." [The emphasis is mine] (p. 186).

Given the relationship among general language skills within the L2 and from the L1 to the L2, SLA researchers advocate increased language practice in all skills, and particularly in the composing process (Raimes, 1985). Researchers also suggest that teachers devote their time to developing writing activities or responding to global aspects of student work rather than primarily correcting sentence-level mechanical errors (Fathman and Whalley, 1990).

Research on Foreign Literature-Based Language Curriculum

There is an apparent trend toward the reinstatement of literature within language courses, and researchers advocate the student involvement in the creative process (Malcolm and Malcolm, 1989; Mayer, 1993).

In a college-level introductory French literature course, Haggstrom (1992) used a highly structured curriculum of lecture, class discussion, written assignments, and dramatic performance. This approach encouraged students to practice all language skills while learning to become independent critical readers and interpret literary works as actors.

Kym (1993) describes how a course viewing East German literature from the perspective of the new Germany raised linguistic proficiency of students of different language levels in one literature class.

Hill (1993) guided his students of English in a literature-based class through the writing process of thinking up ideas for writing topics and developing and revising those ideas into competent works. Final examinations demonstrated students' increased powers of observation, analysis, description, and retention.

Research on Networking in FL Writing

A number research projects at the elementary, high school, and university levels have revealed the positive effects of ESL and FL writing, using electronic mail systems and telecommunications.

In describing his use of a local area network (LAN) at Gallaudet College, Kreeft Peyton (1986) provides a strong theoretical rationale for using Local Area Networks (LANs) for L2 development in writing: 1) students read and write using language that is meaningful, functional, and comprehensible; 2) students are engaged in using written language for a wide range of purposes in a wide range of contexts; and 3) students are motivated to write by communicating with real audiences.

Esling (1987) examined the strategies used by university ESL students as they communicated through an electronic mail network. He found that they used: 1) lengthy tactics to establish topics; 2) play and humor illustrating a strong sense of audience; and 3) transactional language in which they explained presuppositions and negotiated their intended meanings.

Sawyers' study (1989) provides one example of how computer-mediated communication about writing across bilingual classrooms helped change teacher attitudes.

Sanaoui and Lapkin (1992) reported the positive impact upon users' writing performance of a computer network that linked grade 12 Anglophone students of French in Toronto with native French-speaking peers in Montreal.

Varricchio (1992) investigated the effects of electronic mail on the writing assignments of 20 students taking a course in Commercial Spanish at West Chester University in

Pennsylvania. Students used e-mail to write assignments, class information, news items, and comments. Results of the experience indicated students's gains in various skills including those related to business courses, computer use, and technical concepts.

Recent Initiatives in Collaborative Foreign Language Webware Development

It is interesting to observe how the philosophy and the tools of this project are, in different ways, being echoed by current technology discussions over the Internet. For instance, Don Sola, emeritus of Cornell University, in a posting on the American Association for Higher Education (AAHE) mailing list, on April 24th, proposes the collaborative development of a Spanish language database module for teaching writing. Sola promotes the view that effective writing in more than one language should be endorsed as a curriculum objective at all levels, and that Web tools could help attain this objective.

The CTW Mellon Project for Language Learning and Technology at Connecticut College, Trinity College and Wesleyan University, provides another example of current attempts at developing collaborative webware. As the Director of the project, Nina Garrett, explains in another AAHE posting on April 8th, she and her colleagues "are thinking about the possibility of developing courses based on a corpus of interactive multimedia materials on a network connecting the three campuses."

Project's Tools

The backbone of the project will be a sophisticated webware program featuring various real time multimedia units, real time video and audio, and video conferencing tools. Using the program, participants in the project will engage in a variety of written activities provided by the three modules of the program: communication, composition, and literature.

1. Activities in the COMMUNICATION module will be those performed by L2 students writing through e-mail to other students within campus and across countries. An electronic book about letter writing in the foreign language will be included for those students who need formal guidance for epistolary writing. E-mail users at the project's main site will be paired for their writing tasks in French or Spanish, with students of English as a Second Language at the abroad institutions. This pairing procedure will allow the investigation of the effects of peer correction and feedback in L2 writing.[2]
2. Writing activities under the COMPOSITION module will include, among others, stories, reports, articles, instructions and statements of opinion. Students will build their activities upon the contents of a resource database including text and graphic files, audio files, and QT movies. They will be able to consult an electronic book about composition writing in English and in the target language. The books about letter writing and composition will be written conjointly by a team of L1 and L2 instructors at the main site of the project.[3] The resource database will be a shared endeavor of L2 instructors and students at the various sites of the project.[4]
3. The LITERATURE module will provide a forum for written discussions about a literary work under study in a literature/language course taught at any of the sites of the project. Participants will be able to access the writings of their peers, to view and listen excerpts of the most relevant works of the target author, and to browse to the pages of an stylistics manual created by faculty at the main site of the project. The selection and excerpting of the literary works would be a join effort of the instructor and the students taking a literature course at a given site.

The described webware goes beyond traditional writing programs in four ways:

1. it provides a multifaceted approach to writing;
2. it takes into account the learning styles of the potential users by presenting them with activities requiring varying degrees of guidance and/or interaction;
3. it is teacher-driven: the instructors involved in the project will customize the document's activities and resources according to the language they are teaching and the needs of their students; and
4. it is cost-effective: thanks to its open structure, the courseware will be periodically updated, and thus prevented from obsolescence.

Implementation

Optimal implementation of the project will require two years. Year one will be dedicated to: 1) design, develop and field-test the on-line courseware to be used in the project; 2) meet the faculty members of the participant institutions for designing the activities and the research which will be carried out in the project; and 3) contact/meet the members of the advisory committee.[5]

During the second year time will be spent on: 1) implementing the project; 2) getting advise from the members of the committee; 3) assessing the project's central and related issues; and 4) writing and publicizing findings and recommendations.

Assessment

Qualitative and quantitative research procedures will be adopted to verify the attainment of the project's main goal: to enhance the writing skills of L2 learners through the use electronic networking. Writing performance of students participating in the project will be compared with the performance of those who received writing instruction according to the curricula of their schools or colleges.

Related issues, relevant to second language acquisition, literature-based-curriculum and software design will be equally investigated. These issues will include the following:

1. the effects of peer correction and collaborative processes upon L2 electronic writing;
2. the effects of Internet documents use for free-compulsory vs. guided-mandatory L2 writing practices on L2 performance;
3. the impact of electronic writing on attitudes towards the writing process and the writing partners;
4. the impact of foreign literary readings on L2 writing skills;
5. the comparative effects of literature-based and language-based curricula on L2 writing;
6. the impact of user-tailored webware for writing upon users' communicative performance; and
7. the effects of webware design upon processing of content.

Notes

1. There is an essential shift in current research design from regarding comprehension skills as isolated learning to considering comprehension as the basis for speaking and writing (Swaffar and Bacon, 1993). Such a shift should be reflected on the design of the Internet document.

2. Peer correction by native speakers of the target language could turn out to be not only a valid alternative to instructor correction but also an effective way of making students responsible of their own learning, and aware of their cultural identity.
3 If it is true that ability in L2 writing correlates with ability to write in L1 (Gass and Magnan, 1993), instructors of L2 and L1 should join efforts to verify and maximize that correlation.
4 Educational technologists, constructivists (Gay and Mazur, 1993) and postmodernists (Yeaman, 1994), agree on the need of involving students in the development of educational software.
5 The advisory committee could include: Omaggio (Urbana, L2 reading), W. Gilbert Director Technology Projects, American Association for Higher Education), Gay Cornell, Instructional Development & Evaluation), Reeves (University of Georgia, IT Evaluation for Education and Training).

Focus

Instructional Design for Integrating Computer Literacy with K–12 Curriculum Goals

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Key Words: **Instructional design, curriculum integration, K–12, computer literacy, teacher education, applications software, Internet**

Presenters will share three instructional modules based on sound instructional design principles and using computer applications to meet specific curricular goals. Each module includes instructional goals, behaviors/characteristics of target population, performance objectives, teaching strategies and materials (including use of computer capabilities), and evaluation of student performance. Formative evaluation of each module completed through field testing will also be shared. The focus of each instructional design is described briefly below. Taken together, all three modules emphasize the integration of computer literacy skills with "regular" classroom curricula, supporting discipline-related goals rather than treating computer literacy as an "addition" or extra class.

Practicing Problem Solving Strategies at the Middle School Level

The challenging task of creating a course empowering middle school learners to use the computer as a tool was simplified by following the instructional design process.

The goal for the class is: After completing a 75 hour computer class, seventh and eighth grade students will be able to solve real life problems using tool software (word processor, database, and spreadsheet). Students will be able to formulate questions; identify important variables; design an investigation; collect, organize, and interpret authentic data; and communicate their findings.

Instructional strategies include the use of student guides, student-teacher interaction, and hands-on computer applications in support of inquiry in science, social studies, English, etc.

Databases are used to support inquiry of a qualitative nature, and spreadsheets are used in inquiry of a quantitative nature. Providing current resources for high school science topics. The goal of this instructional design is that students will access the Internet to research a topic by using *Netscape*. Skills to be developed include selecting from several available search functions, using search engines/directories to locate information, setting bookmarks, and downloading/saving information for class use. This unit is important to students and teachers as well. Using the Internet, up-to-date information is easily and quickly obtained (in comparison to conventional textbooks or periodicals). Instructional materials include a *Microsoft PowerPoint* presentation to walk students through the necessary steps for successful use of *Netscape* and various search engines.

Enabling Teachers to Highlight Important Subject Matter

Two needs can be addressed by use of computer-constructed classroom presentations. There is a great need for students to become comfortable with the use of the computer as a tool in every classroom; another need is reaching students with materials having both auditory and visual appeal. *Microsoft PowerPoint* enables teachers to use sound, graphics, and movies to enhance and expand the information to be learned. This instructional design was developed to provide inservice teachers with the skills needed to utilize audio-visual computer capabilities to enhance typical lecture notes/outlines. In addition, the seven steps to preparing a teacher presentation (topic selection, outlining, storyboarding, graphics selection and placement, formative evaluation, and revision) can be taught to students as well.

Project

Using Multimedia for the First Time—Middle School

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Key Words: multimedia, HyperStudio, middle school, ClarisWorks, novices

Multimedia projects provide students with a new and interesting way to present an assignment. Students must use critical thinking skills in designing a stack to make the stack as user friendly as possible. Multimedia presentations also give the students access to using technology in a manner that is not normally available to them. Teachers can also make use of this tool for classroom presentations.

In today's schools, unfortunately, curriculum is still being presented in essentially the same manner it has always been. Multimedia projects provide students a chance to demonstrate their understanding of a topic in an original way. Twenty-eight students given the same topic can produce twenty-eight original and different looking stacks. Students are using critical thinking skills because, they have to determine how best to present the material to the targeted audience. This takes a lot of trial and error and constructive criticism by peers and teachers.

Multimedia projects also give students access to using technology in a manner that is not normally available to them. Most students, do not have regular access to scanners, QuickTake cameras, or CD-ROMs. It is not practical for teachers to use these regularly in their lessons. Programs that make use of multimedia allow the student to use his/her imagination and creativity. In addition, schools without World Wide Web connections can begin to show students how hypermedia documents are created. The understanding is present for the future.

Our school district converted to Macintosh computers last school year. Two lab managers decided to try teaching multimedia to various groups of students. Aside from critical thinking skills, there was a desire to enhance the curriculum.

At one middle school a small group of students were asked to participate in a *HyperStudio* project. The students had formal instruction once a week for seven weeks. They were also welcome before and after school. The students were told that after they learned the program they would be asked to be tutors to a group of teachers in the school who were interested in learning to use *HyperStudio*. Lastly, they saw some examples of finished projects and found out that they were now in charge of their very own creations.

Another group began by learning how to make linear presentations using the slideshow feature in *ClarisWorks 3.0*. They were asked to explain who they were and what they liked to do. QuickTake pictures were taken of the students and they used them as part of their slideshows. It was interesting and fun to learn about each student. The results were as unique as each student.

Somewhat later in the year, the same group was then introduced to *HyperStudio*. I wanted to know if they could detect a difference in the ability of the two approaches. After some discussion, one student commented that unlike the slideshow, *HyperStudio* allowed them the freedom to "flip" around in the presentation. Another said it was more like using a remote control approach. They also realized that they still had control over what they were presenting. Middle school students never think that they're in the driver's seat. Teachers interest peeked, when they overheard students discussing *HyperStudio*.

At another middle school, the first group of students taught were gifted eighth graders. They met daily for twelve weeks. Projects took the students two to three weeks to complete, which was more time than I anticipated. The second group were sixth graders who met after school twice a week to create a presentation to be shown to the incoming sixth graders. Seven weeks were spent learning the program, and then approximately two and a half months to complete their presentation. *HyperStudio* Quickcourse, which is very good for a jumping off point, by no means teaches everything *HyperStudio* can do. Students in both groups surpassed this instructor's knowledge very quickly, because they had more time to experiment. Students relied on a lot of peer tutoring.

As far as *HyperStudio* being practical in our particular situations, it is not. This program would be great for a self-contained classroom. Realistically, there is no way that one person would have time to train 550+ students to use *HyperStudio*. However, if we train enough children this year, next year won't be as cumbersome.

All in all, we thoroughly enjoyed letting our student's creativity flow in a way they had not been previously exposed to, and letting them get a chance to use some of the multimedia tools available today. We'll both continue to use *HyperStudio* despite of the amount of time necessary to complete projects and the lessons we learned.

Project

Successful Searching on the World Wide Web

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Key Words: **search engines, Internet, World Wide Web**

One of the most useful features of the Internet for educators is being able to search for information on a topic of interest. Two types of searches are most useful on the World Wide Web (Web). They are search trees and search engines. Search trees take the user from a broad topic such as education to progressively narrower topics. At each level of the tree, the user may choose to explore the links provided. As the search is narrowed, links to information are provided within the search. Trees are effective tools when the user has a broad topic and needs to focus a search or narrow topic.

Examples of Search Trees are:

- Clearing House for Subject-Oriented Resource Guides (http://www.lib.umich.edu/chhome.html)
- Virtual Library (http://www.w3org/hypertext/DataSources/bySubject/Overview.html)
- Yahoo (http://www.yahoo.com/)

Numerous search engines such as Lycos, Open Text, and WebCrawler are available on the Web. Some search only Web pages while others such as Lycos also search ftp sites and Gopher indexes. Knowing which one to use for a particular purpose can result in a quick efficient search.

The following are ways to focus or narrow search engine searches. They usually result in a fewer number of hit but ones that are on target. Searching for a phrase instead of individual words is available on some search engines. Boolean operators such as "and," "or," and "but not" can be used with some search engines to narrow the search. The Open Text search engine allows users to continually refine the search to focus on a narrower topic. Open Text provides links to like searches and the option to view text with the keywords highlighted.

Examples of searches on educational topics from various search engines will be demonstrated during the session. Several search engines will also be demonstrated. Examples of the best search engines for specific subjects will be presented.

Addresses of Some Good Search Engines are:

- InfoSeek (http://www2.infoseek.com/)
- Lycos (http://www.lycos.com)
- Open Text (http://www.opentext.com:8080/omw/f-omw.html)

Focus

Integrating Internet into Undergraduate Education

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Key Words: **undergraduate education, educational technology, Internet, World Wide Web**

This session identifies the change process necessary to encourage faculty to integrate Internet into teacher preparation classes. It also identifies the most essential Internet information for teachers.

The integration of Internet into teacher preparation classes first requires faculty awareness of the educational possibilities of Internet. For wide usage, the Internet access must be convenient and easy to use. Next, staff development opportunities must be available as well as brief individual assistance on demand. Once these steps were completed, student and faculty use of the Internet increased dramatically.

Internet is taught in the basic educational technology class that is required of all sophomore elementary education students. The class introduces students to technology that they will use in upper division education classes and in the schools. The technology class focuses on tool software (*Microsoft Works*), *HyperCard* and multimedia, and Internet.

This is the third year that Internet has been included in the class. When we had only a command line interface, students began using Internet with e-mail. Mailservs were the logical next step because they required the same skills as e-mail. Next students learned to use Veronica to search Gopher menus because it provided easy menu-based searching. *Lynx* was later substituted for Gopher searches. When full Internet access became available, *Netscape* replaced *Lynx* as the browser for accessing information on the World Wide Web.

To make change in campus access to a Graphic User Interface, it was necessary to demonstrate to administrators and faculty what could be available at their fingertips. During the summer of 1995, students in two graduate Internet classes were provided free direct Internet service through an Internet Service Provider Grant. One Internet class culminated in a Net Fair. Public school administrators and teachers, campus personnel, students, family, and friends were invited to attend. Students from the class demonstrated e-mail, searches, virtual tours (Louvre and the White House), simulations (frog dissection), home pages they had created, and other sites of interest. About 100 people including public school administrators and campus officials attended. As a result, I was invited to demonstrate *Netscape* for the College of Education and Human Services (CEHS), other campus groups, and the Montana State Board of Regents. These demonstrations created an awareness of the educational resources on the WWW and hastened the adoption of the TCP/IP protocol on campus.

By Spring Semester 1995, *Netscape* access to Internet was available to students in the Math Science Technology Center (MSTC). I was given reassigned time to provided half day staff development workshops on surfing the Web and effective searching. I always begin Internet classes or workshops with small group discussion on what is Internet and what have they hear about Internet. This builds on their current knowledge and brings out misconceptions and questions.

The faculty was now aware of available Internet resources and had easy access to those resources. The focus now shifts to a description of Internet instruction in the technology class and then to the integration of the technology into undergraduate methods classes.

Current undergraduate Internet instruction focuses on using e-mail, finding resources, and managing Internet in schools. Students are encouraged to bring Internet addresses of friends or family to class so that they have a meaningful purpose for e-mail correspondence. Students are introduced to the concept of e-mail using *Eudora* software. They create a class distribution list and participate in class discussions on the Internet. Some assignments are turned in online rather than in hard copy.

Next they explore educational sites on the Web using *Netscape* and subscribe to an educational mailserv. I provide a list of about 80 mailservs of interest to educators. We do not have campus access to Newsgroups or that would provide an alternative choice for a discussion forum.

Finally, they are introduced to searching the Web using search trees and search engines. They use at least two search engines to search for a topic of their choice and compare the information that they retrieved from each search. Some of the current search engines that they use are Yahoo, WebCrawler, Open Text, and InfoSeek.

Students discuss issues concerning the use of Internet in K–12 education. Because of the limited amount of class time available, we discuss netiquette, acceptable use policies, and programs that block access to objectionable areas of Internet only briefly.

To provide a focus for subject area methods classes, during the Spring 1996, graduate students in a telecommunications class developed home pages for undergraduate methods classes. These students met with individual faculty to identify topics of importance for each class. Sample topics include the Model United Nations for social studies, art for special needs students for art class, and lesson plans for graphing calculators for math. The graduate students then searched the Web for information sources on the requested topics and presented sources to the faculty member for selection. From these selections, the graduate students developed and posted a home page for each professor. That was an easy way to get all faculty using the Internet in methods classes. An extra benefit was the informal instruction provided to faculty in a non-threatening environment. It also became a meaningful activity for graduate students to use newly learned skills of finding information on the Web and authoring Web pages.

In math, science, and social studies methods classes, students are required to use Internet for class discussions and to search for information. As more of the public schools have access to Internet; field experience students are also using e-mail to contact faculty. All College of Education faculty have Internet access using *Eudora* and *Netscape* from their desktop computers. Many of our students are placed in Professional Development Schools (PDS) for junior field experiences and student teaching. I am working with our seven PDS sites to introduce faculty to the Web and to teach selected faculty to create and maintain Web pages at the Montana State University Billings site.

Through an introductory technology class, practice in methods classes, and during field experiences, students are becoming comfortable integrating Internet into their teaching and learning experiences. Faculty are informed and supportive of information technology through staff development opportunities and work with students.

Focus

Music, Videodiscs, and Mentors: One University's Approach to Faculty Development

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Key Words: **faculty development, instructional technology, mentoring, videodisc, telecommunications, hypermedia**

In the spring of 1991, a decision was made to eliminate the course, "Applications of Technology in Education" from the preservice teacher education program. The theory behind this decision was that technology should be integrated into the foundations and methods courses. Some of the faculty tried to do this; others needed assistance.

To meet this need the college hired a Director of Faculty Technology Development who was specifically assigned to assist faculty in developing skills in the area of instructional technologies. The first year, his main focus was a cohort group of eight faculty members, two from each department.

During this year, he created a five-tier plan to help infuse technology into the curriculum:

1. The Director would teach the technology component of the class. The faculty member would be a participant.
2. The faculty member would team teach with the Director.
3. The faculty member would teach the technology component by himself/herself.
4. The faculty member would create a new project and present it either to his/her class or at a conference. He/she might or might not choose to team with the Director.
5. The faculty members, by himself/herself, would create a technology product.

The faculty members with whom the Director worked were at different levels. For faculty members at the first level, he would teach the technology component of the class while they observed. In this situation, he frequently demonstrated his award-winning classical music videodisc, Tropical Suites. Faculty members who advanced to level three would teach the technology component themselves. Although their approach to the topic might be different than the Director's, many faculty members used the handouts he had created when he taught the technology component. Several faculty members who started using technology in their preservice courses began to use the technology when they presented at conferences. Frequently their conference presentations focused on what their students were doing with technology in the classroom. One faculty member reached level five and created her own videodisc which she uses in teaching gymnastics.

Although having a Director of Faculty Development on staff certainly increased the use of technology in the foundations and methods courses, there were still a number of faculty members who needed assistance in this area. Therefore, it was decided to have students in the Educational Technology Masters degree program mentor college of education faculty as part of the requirements for the course, "Educational Technology: Theory into Practice."

"Educational Technology: Theory into Practice," was designed as a practicum course. This course was designated as a culminating experience for those enrolled in the program. In this course, the students met with their instructor once a week to discuss educational technology theories and technology topics. The purpose was to equip students with strategies and techniques to assist others in utilizing technology. They also were required to meet at least two hours a week with their faculty protégé. During the mentoring time, students worked with their faculty protégés to help them acquire new technology skills; improve previously learned ones; and assist them in integrating technology into the classes they taught.

Faculty protégés were interested in several areas of technology: presentation software, telecommunications, interactive multimedia, and integration of commercial software into classroom instruction. Although they were introduced to all of these areas, most of them chose one area upon which to focus. The two most widely used technologies currently are presentation software and telecommunications.

Both of these projects have had a ripple effect on the use of technology by the college faculty. The number of faculty members who use technology in classroom instruction in their preservice teacher education courses has increased. Some of the faculty members who were mentored either by the Director of Faculty Development or by a practitioner graduate student are now mentoring either fellow faculty members or K–12 teachers or both. Finally, the preservice teachers are now better prepared to use technology in a K–12 setting.

Project
Restructuring Teacher Education with Technology

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Key Words: **multimedia, collaboration, foundations curriculum**

Introduction

Most university students enter the field of education with a preconceived vision of the roles of teacher and student based on their own school experiences. They quickly discover that picture has changed with the advancements in technology. As Howard D. Mehlinger emphasizes in the February, 1996 issue of Phi Delta Kappan, "The new technologies provide students access to information that was once under the control of teachers. No teacher can compete with the power and capacity of the new technology as a presenter of information." Consequently, the roles of teacher and student are going to evolve as technology allows students to take charge of their own learning. This case study describes how students in the college of education at a state university experience the changing roles when they are partnered with students at an elementary school in central Florida.

The Vision Center

A partnership between the elementary school and the College of Education was enhanced by the receipt of the Apple Partners In Education Grant II. All systems were "go!" as the school year began. Altamonte Elementary implemented a major restructuring of their K–5 program and learning communities were created. One community called the Vision Center was comprised of 120 third, fourth and fifth grade students combined in multi-age classes to create a "school within a school." The students rotate among four teachers who specialize in math, science, language arts, and technology.

Role of the Teacher

The technology teacher in the Vision Center works with each class of intermediate students six hours a week through block scheduling. The classes work on long-term projects to be buried in a time capsule including an interactive map of the central Florida area and electronic field trips. The students learn about their world and create a picture of it for the future. Most of these projects are done using *HyperStudio*.

The project-oriented focus changes the role and responsibility of the teacher. Each class begins with student leaders sharing their teams' progress on the project checklist and the team's plans for the day. This is followed by a short lesson on some aspect of the project planning and implementation. During project implementation the teacher and university students manage multiple groups of students, solve problems, and provide overall project direction while learning along with the students. It is impossible for the teacher to be the constant expert as subject matter is open-ended and constantly unfolding.

Teaching Strategies I Course

Two sections of Teaching Strategies I were invited to complete their required field experience in the Vision Center. One section was even held at the elementary school. To prepare university students to volunteer in the Vision Center, all of the field experience students were required to complete a tutorial on *HyperStudio* before beginning the field placement. They also had a semester assignment to complete their own *HyperStudio* stack, which could be used in their future classroom.

The university students were immersed in learning once they started volunteering at the elementary school. In each technology class, the college students worked with teams of Vision Center students to research and prepare individual *HyperStudio* stacks. Student teams were paired with one college student for each assignment, and the teams met weekly. The elementary classroom teacher modeled for these new teams the steps to follow in completing each project. The teams worked cooperatively and collaboratively throughout the project. The technology project targeted the needs of the elementary and university students simultaneously.

The Roles of Learner and Coach

The roles of learner and coach were constantly alternating between the team members. The university students became much more creative with their technology projects as they witnessed how the elementary students experimented with color, graphics, and sound. The elementary students boasted about the many computer "tricks" they taught the university students. The university students provided great incentive for the elementary students to work hard and do their best They made learning fun! The work of the elementary students took on a new depth because of the support available to them through their university partners.

Summary

The major goal of the partnership between the College of Education and the Vision Center has been realized. Teachers, professors, university students and elementary students are sharing roles as learner and coach collaborating on technology projects. The positive effects created by this technology experience will encourage these future teachers to incorporate technology into their teaching and learning environment. These students received a head start on the learning process as they learned how to apply technology and experienced a project-oriented classroom.

References

Mehlinger, H. (1996). School Reform in the Information Age, Phi Delta Kappan, 77 (6), 400–407.

Society

CMC—Tool to Measure Secondary/Post-Secondary Student Expectations and Curricular Change (ISTE SIGCS)

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Key Words: **computer-mediated communication, computer science education, curricular change**

Abstract

The heightened awareness and availabilities of computer-mediated communication (CMC) tools on LANs, WANs, the Internet, World Wide Web (WWW), and so on have tremendously increased the potential for student feedback on both the secondary and postsecondary level. Debates over the issues of curricular reform, programming language suitability, computing literacy versus computer science, and so on continue to waged without the component of student input or the cross-communication of high school and college CS teachers.

Students majoring in Computer Science (CS) and heavily related computer majors form experiential opinions about the needed changes in their programs on the secondary level. The same students also establish opinions about necessary curricular changes for their University programs once they are in the workforce.

CMC allows for the gap between secondary computer science education and college computer science programs to be shortened and bridged. Instructors on the secondary level are now able to continue communication with their former students who have matriculated into CS majors and use the feedback from these students to change their programs to better serve future CS majors.

A natural outgrowth of CMC in this area creates awareness and collaboration between high school and college CS teachers. Students coming out of well-developed, high school programs may not be served well by the standard college CS regime, while students from less developed high school CS programs may need added attention. The use of CMC to bridge the college-high school curricular gap is a phenomenal step forward in that it precipitates mutual exchange rather than trickle-down or isolationist approaches.

Three students completing their Freshman year in computer science at their respective universities (Carnegie Mellon University and Rose Hulman Institute of Technology) will outline their concerns relative to their high school experiences versus matriculation into CS majors. They will also briefly outline special opportunities that were available on the

college level and those that they believe should be implemented. Their former high school instructor will be available to describe their secondary program of study and its evolution as well as indicating the need and projection of a model for communication between high school teachers, their alumni enrolled in CS majors, and their professors. CMC is anticipated to create the affordable and available vehicle for the enhancement of both secondary and postsecondary CS education.

Project

Computing for Every Teacher in Every Classroom: How to Do It!

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Key Words: **planning, district, K–12, fund-raising, implementation, networking**

Overview

The principle goal for this project session will be to inform a general audience of what can and what can not be done when an additional $360/student allocation is made available for technology in a K–12 school district. Many of the recent experiences gained by the Mounds View Public Schools, one suburban 14,000 student population Minnesota school district which implemented a successful $5 million instructional technology bond project, will be explained. Included in the session will be comments on the district's assumptions, goals, and outcomes aimed at increasing: 1) the amount of technology available to classroom teachers, 2) staff development and utilization related to technology, 3) technology support and coordination, and 4) technology research and development. Percentages and amounts of funds that have been available to individual school buildings and to the central office for purchases of hardware and software will be shared. A summary of the lessons learned, problems encountered, and solutions in place will also be presented. The session assumes no particular technology awareness level and is intended for education administrators, technology coordinators, students, and teachers.

Specific Items for Sharing

Up-to-date information will be available detailing the planning assumptions and spending allocations used for the two phases of the bond project. The planning information will include a discussion of the roles for the technology staff, special interest groups, a district-wide technology committee, district administrators, and the school board. Information on valuable lessons learned will be shared, including 1) working with the community's intent, 2) the changing nature of what constitutes a computing workstation (both teacher and student), and 3) the critical importance and high cost of networking. Whether to do classroom presentations via LCD panels or via the use of mounted TV monitors is an on-going issue that may not be resolved by conference time. The rationale for the decision made in Mounds View to use TV monitors instead of overhead projector panels will be explained.

Distribution of Funds

Comments related to spending allocations will detail the budgets planned and the actual expenses for categories such as local-area and wide-area-networking, building wiring, workstations and televisions, district-wide site licenses, and discretionary funds for individual buildings. Topics to be highlighted during the presentation will include the rationale for deciding on what single workstation (Macintosh 5200) to place in every classroom, how many discretionary dollars to allocate to each building ($150/student), and how large to make the network capacity at each building. The accounting method for keeping track of all expenses for all building centered around the use of *Quicken* on a workstation, and served the district very well.

Training and Support Considerations

Vastly increasing the number of computers in the district while slightly increasing staffing to support the new users and applications made for some hectic and stressful times, but many solutions to an wide array of problems were also discovered. Using the capabilities of *Netware 4.x* and the Wide Area Network (WAN) assisted in providing additional support services. Making and distributing video tapes for training purposes served was a key to addressing the major training needs. Training and support needs are being met, but will continue for an extended period.

Networking and Connectivity Lessons

Information will be shared regarding lessons learned in using *Novell 3.x* and *4.x* as the network operating system to connect all of the district's workstations. One specific example to be discussed will be the details as to the successful inter-cabling of every classroom in the district for file and printer sharing, single application e-mail usage, and general Internet access. Installing and configuring a telephone, network connection, computer, and television into every teaching space in the district is complete. Making services, such as Internet access available to one thousand teachers and several hundred staff in the district was a major goal. Fulfilling such a goal is difficult, contrary to what the general population is led to believe about the ease of use of the Internet. While fantastic Internet services such as World Wide Webs are now available to every teacher and student, new problems such as censorship of newsgroups and bulletin boards, home access, and unwanted e-mail are now in front of us. There are solutions to these issues, but it takes risk, cooperation, and leadership to forge paths that others can follow successfully. Lessons learned in these areas will be shared.

Summary

Results of our efforts are becoming known and one thing is for sure—we must keep investing and changing in order to address the new needs, challenges, and opportunities. A major infusion of technology money into an instructional program is great, but it does not produce a permanent solution. Additional funds for capital equipment and particularly for additional support services must continue to be obtained for a community and district to fully utilize and benefit from their investment in technology.

Project

Using Interactive Videodisc Systems to Teach Math and Algebra at Wisconsin Worksites

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Key Words: **math, algebra, videodisc, multimedia, worksite, interactive, BASIC**

Overview

Employees of many Wisconsin businesses need to learn or review basic math and algebra. Because the skills levels of these employees vary greatly, a regular class can be too slow for some and too fast for others. In addition, a class cannot be offered at a time convenient to everyone. In response to this problem, the Wisconsin Technical Colleges have developed an Interactive Multimedia Videodisc Instructional System which allows the colleges to provide Wisconsin businesses with individualized, self-paced, open-entry basic math and algebra courses at the worksite 24 hours per day.

The system consists of a multimedia computer, videodisc player, 71 math/algebra full-motion video lessons on 36 double-sided videodiscs, and interactive software with assessment, recordkeeping and testing. These systems are being used in about 100 businesses. Students use the computer to control the videodisc player and can pause, review, move ahead or switch between testing and video instruction with the touch of a finger. Students can learn to use the system in five minutes. The systems are never judgmental, allow safe failure, and provide performance-based, open-entry instruction 24 hours per day.

Some users have reported that using this interactive system versus standard instructional methods has increased their retention of students enrolled in basic math/algebra by 40–50%. In addition, in recent surveys of students using the interactive system, 80% of the students surveyed indicated that the system helped them learn math faster and better, and made learning less stressful and more enjoyable.

The System

The Level III Interactive System, which was originally developed in 1988, currently consists of an Interactive Hardware Station made up of a videodisc player, multimedia computer and video graphics card; 39 interactive pre-algebra math full-screen/full-motion videodisc lessons on 20 double-sided videodiscs; 32 interactive algebra videodisc lessons on 16 double-sided videodiscs; and 44 interactive AC/DC electronics videodisc lessons on 22 double-sided videodiscs. The system also has computer programming with comprehensive record-keeping and testing package.

The interactive videodiscs will also run on almost any other interactive videodisc hardware platform, including InfoWindow, DVA-4000, M-Motion, School Board, New Media Graphics and SonyView. A CD-ROM MPEG I conversion is now being explored. A list of math/algebra lesson titles is shown below.

Modumath: Arithmetic

Naming Whole Numbers	Dividing Fractions
The Number Line	Ratio and Proportion
Adding Whole Numbers, Part I	Understanding Decimal Fractions
Adding Whole Numbers, Part II	Adding and Subtracting Decimal Fractions
Subtracting Whole Numbers	Rounding Numbers
Multiplying Whole Numbers, Part I	Multiplying Decimals
Multiplying Whole Numbers, Part II	Dividing Decimal Fractions
Multiplying Whole Numbers, Part III	Changing Fractions to Decimals
Exponents	Square Roots
Dividing Whole Numbers, Part I	The Meaning of Percentage
Dividing Whole Numbers, Part II	Percent in Word Problems
Word Problems	More Problems in Percent
Solving Equations	Signed Numbers
Prime Numbers	Adding Signed Numbers
Introducing Fractions	Subtracting Signed Numbers
Re-Naming Fractions	Multiplying Signed Numbers
Adding Fractions with the Same Denominator	Dividing Signed Numbers
Adding Fractions with Different Denominators	Signed Fractions
Subtracting Fractions	Negative Exponents
Multiplying Fractions	

Modumath: Algebra

Getting Acquainted with Algebra	Systems of Equations IV
Order of Operations	Exponents
Addition and Subtraction of Algebraic Expressions	Factoring I
Multiplying Polynomials	Factoring II
The Laws of Algebra	Factoring III
Solving Equations, Part I	Simplifying and Dividing Polynomials

Solving Equations, Part II	Rational Expressions I
Using Equations to Solve Problems	Rational Expressions II
Solving Practical Problems	Rational Expressions III
Inequalities	Rational Expressions IV
Linear Equations and Graphs I	Roots and Radicals I
Linear Equations and Graphs II	Roots and Radicals II
Linear Equations and Graphs III	Quadratic Equations I
Linear Equations and Graphs IV	Quadratic Equations II
Systems of Equations I	Formulas
Systems of Equations II	Variation & Proportion
Systems of Equations III	

The System Users

About 350 Systems are currently being used in Wisconsin. Included among the users are all Wisconsin Technical Colleges, High Schools, Libraries, Community-Based Organizations and about 100 Businesses, including Ambrosia, Bollens, Briggs & Stratton, Centrifugal, Cutler-Hammer, Elektrotek, Fendahl, Freeman Shoes, Greenheck Fans, Harley-Davidson, Harrisfager, James River, Johnson Controls, Kimberly Clark, Kraft Foods, LaCrosse Footwear, Lakeshore, Inc., Master Lock, Motor Castings, Navistar, Paper Converting, Plastic Ingenuity, PM Plastics, PPG Industries, Presto Products, Proctor & Gamble, Rayovac, Schreiber Cheese, Serigraph, Springs Window Fashion, and SSI Technologies.

The Way the System Is Used

Systems are placed in a business learning center, library, classroom or any convenient location. Students are individually enrolled, one student per system per hour, to learn precisely what they need to learn. Students use the computer to control the videodisc player and the pace of instruction. Students can rewind, pause, fast forward, and switch between testing and video instruction with the touch of a finger. Based upon the responses to questions, students are given the specific, individual instruction they need. System use is monitored by an appropriate instructor.

The System's Instructional Advantages

Students can learn to use the systems in five minutes. The systems are never judgmental, provide positive reinforcement and allow safe failure. They are portable and available on-demand 24 hours per day. The systems also provide self-paced, individualized, performance-based instruction. The student-controlled systems allow for open entry/exit enrollments and provide computer-based testing and records management. The LaserDiscs are also barcoded for use in classroom presentations.

System Effectiveness

Some users have reported that using this interactive system verses standard instructional methods has increased their retention of students enrolled in basic math/algebra by 40–50%.

In addition, in recent surveys of students using the interactive system, 80% of the students surveyed indicated that the system helped them learn math faster and better, and made learning less stressful and more enjoyable.

Focus

Creating an Electronic Community on the Internet

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Key Words: **Internet, disabled, community, electronic**

Electronic communities can be created without restrictions imposed by time and distance. Often, an electronic community begins with an organization of people in a geographical location who wish to communicate efficiently, but grows far beyond the original geographical boundaries. Other communities begin with a common interest among people separated by distance.

DO-IT (Disabilities, Opportunities, Internetworking and Technology) provides an example of a successful electronic community that was formed around common interests. In 1995, it was selected for the National Information Infrastructure Award in Education for its innovative use of the Internet in education. Directed by the University of Washington and primarily funded by the National Science Foundation, DO-IT makes extensive use of computers, adaptive technology and the Internet to increase the successful participation of people with disabilities in academic programs and careers in science, engineering, and mathematics. With computers, adaptive technology and modems in their homes, pre-college students, "DO-IT Scholars," form a strong support group with each other; communicate with successful college students and career Mentors; correspond with program staff, and make use of Internet resources around the world. The Internet provides assess to information and people that help in their pursuit of educational and career success.

The DO-IT electronic community uses electronic mail, chat and talk to facilitate communication between its members. Several electronic lists facilitate small group and large group discussions. For example, the DO-IT Scholars have their own list at doitkids@u.washington.edu. The Mentors can communicate with each other on mentors@u.washington.edu. Much of the community discussion takes place on a combined list of Mentors and Scholars. Others who are interested in the goals of DO-IT can participate on an open list doitsem@u.washington.edu. Gopher and World Wide Web (WWW) servers provide a location for DO-IT materials, related articles and publications, and links to other useful resources. The URL for the DO-IT WWW page is http://weber.u.washington.edu/~doit/.

The success of the DO-IT electronic community can be attributed to a lively group with common interests, the distribution of training materials, staff intervention to keep discussions alive, and the availability of computer systems and Internet connections for all members of the community. The conclusions of Riel and Levin, in their 1990 article titled "Building Electronic Communities: Success and Failure in Computer Networking" (*Instructional Science*, volume 19, pages 145–169) are consistent with the experiences of the DO-IT. They found that in successful electronic communities:

- Participants work closely and actively with each other but are geographically or physically separated;
- All participants have easy and equal access to the network;
- There is community pressure to read and respond to mail regularly and in a timely manner;
- Asynchronous group communication (parties are not online at the same time) is more efficient for this group than other types of communication;
- There is a mutually-shared goal or well-specified task to accomplish;
- There is a facilitator or moderator to encourage group interaction;
- There is a group structure (rather than individual-to-individual communication);
- There are established educational goals with a time line and an identifiable end product;
- There is a coordinator or moderator to facilitate group planning.

Riel and Levin recommend that electronic community planners ask the following questions before establishing an electronic network:

1. Does the group already exist—do they already know each other?
2. Does the group have a need for telecommunications?
3. Is there a shared goal or task with a specified outcome?
4. Is there easy and efficient access to technology?
5. Do participants have regular patterns of accessing mail?
6. Is there a person who will facilitate group planning and work?

If the answers to the majority of these questions are "yes," then Riel and Levin predict that it should be relatively easy to establish an effective electronic community.

The formation of electronic educational communities offers a chance to rework the educational system and capitalize upon the strengths of computer-mediated communication. If implemented properly and accepted by their users, electronic educational communities can potentially have far-reaching effects. They can promote active and collaborative learning among students; provide new, up-to-date, and interactive educational resources; enhance the strengths of the current educational system; and overcome the limitations of the traditional classroom environment.

Focus
Strategies for Effective Professional Development of Classroom Internet Users

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Key Words: Internet, training, teaching, integration, strategies, classroom, learning

Are you responsible for the professional development of educators using the Internet in their classrooms? Are you searching for strategies to assist teachers in both their personal learning and classroom application of the most popular Internet tools? Are you wondering how you can offer an Internet workshop that will give the teachers practical ideas and methods to use upon return to their classrooms? Are you looking for alternative methods of professional development—perhaps some ongoing solutions? Four computer consultants from Winnipeg, Manitoba, will present their favorite tips and techniques in professional development for the classroom Internet user in this focus session.

The speakers will deal with some key aspects of Internet professional development: 1) workshop design, 2) approaches for teaching specific Internet software clients, 3) techniques for encouraging effective integration of Internet resources into the instructional program and 4) other long term professional development strategies. Examples of workshop methodology will be demonstrated using the most popular Web browser and e-mail applications, *Netscape* and *Eudora*. As well, the construction and instructional use of home pages will be discussed.

Choosing how you are going to transmit the skills in a workshop is as crucial as the choice of what you teach. There are many strategies for enhancing the learning of participants that will enable you to overcome restrictions imposed by limited computer or connectivity resources. Surmounting the limitations of the one modem classroom, for example, may be accomplished by the use of online simulations. It's all in the planning.

One key decision you will make in advance of the workshop is that of choosing the closing activity for the participants. Are they to terminate the workshop by sending an e-mail message to Australia? Will they post a message to a listserv or subscribe to a newsgroup? Will they modify and post a home page? Tangible results will result in satisfied customers. Other important workshop planning decisions include: the selection of a theme for the workshop, the establishment of a realistic workshop time line, the grouping of participants, the selection of handouts and diskettes and the planning of follow-up activities to reinforce the skills taught in the session.

Workshop strategies also include a host of tips and tricks that relate specifically to the use of technological tools in sessions. The use of an LCD panel calls for special consideration as does any attempt at cross-platform workshops. Above all, when working with technology, it is vital to retain a sense of humor.

Learning the nuts and bolts of Internet clients, such as *Eudora* and *Netscape*, is not the focus of this session. Rather, hints on methods of teaching these nuts and bolts will be discussed. The key is to raise the participant to the point of being an independent learner. Often it's more the confidence that needs a boost than the skill level. Technical tips, such as how to allow multiple users to access *Eudora* through one computer and modem, will solve some typical problems.

The immediate question which arises for the classroom teacher, after gaining some Internet awareness, is how to integrate the new tools into classroom learning. Professional development on Internet topics is most effective if workshop methodology and planning of technical considerations permit a focus on the learning implications of Internet use. Examples of how the teacher can use the Internet in an interdisciplinary fashion will be shown.

Home page creation is one method of allowing the Internet user to become an Internet contributor. The burgeoning home page phenomenon within school districts also calls for the development of guidelines for home page authors. Questions of privacy, designation of official school pages and maintenance of pages will be discussed.

The Internet workshop is not the only option open to those responsible for professional development. There is a host of other strategies that may be used as alternatives or supports to workshops. Some other activities are: 1) the Internet hunt where participants are guided through increasingly difficult tasks, 2) the use of Listserv to regularly share gems and classroom hints, 3) the publishing of district newsletters on the World Wide Web as another sharing device, 4) the formation of special interest groups that meet regularly to compare notes, 5) the use of the trickle down technique in professional development, where workshop participants are expected to share their knowledge with others and 6) the provision of Internet client install packages that ease the first steps for novice users.

The presenters work in neighboring school districts in the same city, where they have been fortunate to cooperate closely in joint professional development initiatives. Now, with a school district boundary review on the horizon, cooperation is becoming an essential part of their roles. Adding another challenge is the mix of computer platforms within the city districts, explaining the Macintosh/*Windows* cocktail that you are invited to share.

Project
QuickTime Virtual Reality's Endless Educational Possibilities

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Key Words: **virtual reality, electronic instruction, exceptional education**

Teachers and students are developing *QuickTime* Virtual Reality (QTVR) products at Edgewater High School in Orlando, Florida and at the Public School for the Deaf in New York City. The Multimedia production classes are working in conjunction with non-profit clients to create museum kiosks, enhancement pieces for other projects, and products for physically and mentally challenged people.

QTVR is a *QuickTime* movie product developed by Apple Computer, Inc. which allows the user to interact with the *QuickTime* movie by controlling which direction the movie will go next. These movies can be connected using hot spots that allow the user to open another *QuickTime* movie. There are two types of movies that can be constructed. One is a panoramic view of a place and the other is an object movie. Both types of movies can be linked together to give a comprehensive view of a scene.

In Orlando one team of students and teacher are working with the Orlando Museum of Art to create a virtual walk through the pre-Columbian exhibit that is owned by the museum. What will make this project different from others viewers have seen is that it will be totally produced by the students and teacher. Each museum piece will be individually photographed for object movies and an overall panoramic view will allow the users to choose individual objects to study more closely. This project will be distributed in CD-ROM form to schools in the nine-county area surrounding the museum. Many classes visit the museum and will use the CD-ROM both as a preview for their visit and as a follow up activity. Others will use the virtual museum as a reference tool. Students doing reports will be able to copy and paste media selections from the museum CD right into their projects.

A long term QTVR project involves helping mentally challenged high school students learn appropriate behavior as well as the layout of their work site before they begin their jobs. At the beginning of each school year mentally challenged students are prepared to enter the work force as part of their school curriculum. The places of employment for these students remains fairly static. The employment places that are used most will be photographed for panoramic views and made into QTVR scenes. Additional information will be added to the movies in forms of prompts to help the students practice appropriate behaviors. The student starts with a QTVR panoramic entering the work place. The next view takes the student to the employee check in area. Next the program would prompt the student to greet someone in the employee check in area and place their book bag in a locker that has been assigned to them. The teachers involved hope that using QTVR with the students before their employment begins will help them to learn the ropes and become better employees faster. We hope to answer the question of "Will the students be able to transfer the learning from the QTVR scenes to the real work site?" through this project.

In New York, in the Special Education District, one "special" QTVR endeavor targets children who cannot lift or manipulate objects at all. It is called the "Virtual Strolls" project. Common objects are digitally captured and made navigable. They are then set in a location context. These objects can then be lifted, turned and upended electronically by students using an infrared head pointer. This way the most ordinary of interactions—lifting a spoon, pen, toothbrush—becomes part of the child's experience, empowering a formerly permanent observer.

Another project combines QTVR and the World Wide Web. This involves creating an online, navigable catalogue of access technology. The adaptive objects are constructed in vocational shops by special students for other children with special needs. These products, currently featured in a hard copy catalogue, would be posted as a kiosk like image map. When an object is selected it downloads and plays with the help of a QTVR player (obtainable free from the Apple Computer web site). Teachers, parents, clinicians and students can browse and manipulate all these products as well as send questions and feedback regarding each device displayed.

Have you ever needed a particular audio, video or computer connector and didn't have a clue as to what it looked like? This is another project under construction that will use QTVR applications. The connectors object movies will be included as part of a CD-ROM product "T5: Training, Tips and Tools, for Technology-using Teachers." The T5 project was inspired by teachers who live in isolated parts of South Dakota and Nebraska who need resources like these.

Object movies are being created of a private collection of crystals and minerals. This set of QTVR movies will be developed into an instructional style interactive CD-ROM reference for use in science classes.

The equipment and software requirements for creating QTVR movies are hefty. A special photographic rig is needed for creating QTVR object movies that move on a vertical axis and another type of rig is needed to shoot panoramic movies. While development of QTVR may be limited, the possibilities of using this new technology in schools are endless.

Project
Instructional Benefits of a Schoolwide Network

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Key Words: **networking, instructional technology, curriculum integration, Internet**

This project will highlight the enhancements to instruction that were brought about by the addition of a schoolwide network at a middle school with a student population of over 1600 in the suburbs of Atlanta. After a full year of implementation issues such as increased communication, file sharing, media center resource access and Internet connectivity were surveyed. Overall results as to level of benefits to instruction were positive.

The cross platform network included five central servers (courseware, administrative, communication, media center, and e-mail), three computer labs, networked CD-ROMs, and 56K frame relay for Internet connectivity. Each classroom had a networked Power Macintosh.

Staff and student training was a significant factor in the successful use of the network. By offering consistent orientation to network navigation and through the development of user manuals for teachers and students the various components of the network could be accessed with considerable ease.

Student work on projects were enhanced by the disk-free environment. The vulnerability and size limitations of the floppies used in previous years gave way to the ubiquitous, reliable and increased storage capacity of our five gigabyte server that housed student and teacher files. Multimedia projects were created and shared with new zest by teachers and students.

By establishing curriculum forums on the network and selecting content area forum leaders, teachers were able to share files for management, lesson plans, assessment, computer integrated lessons, and classroom presentations. Teachers also generated HTML files that focused on curriculum topics that were utilized for classroom and lab Internet usage. The Internet as well as networked modems provided many avenues for global connections for a wealth of student communication with experts, other schools and general information.

One of the greatest assets of the network was the connectivity to a wide variety of reference resources. The media center to classroom connection included linkage to the electronic card catalog, SIRS, EBSCO, and Information Finder. The media center to classroom automated logins were accomplished by the use of an AppleScript. Ways in which an ethics policy, online time management, and large group presentation systems maximized the use of the network will also be discussed.

For more information see article, "Networked: Trickum Middle School's network is up and running." *Curriculum Administrator*, January, 1996.

Focus

Right On Target: Empowering At-Risk Teachers

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Our focus today is to examine ways to help fellow teachers into the Information Age and onto the highway to technology and information literacy. We would like to look at strategies for helping teachers overcome fears related to technology and strategies for inservicing them.

Who are At-Risk teachers? What can we do to ease them into an integrated curriculum with technology as the invisible web holding it together?

In the October 1995 issue of *T.H.E. Journal*, guest editor William A. Talkington talks about the multimedia systems being introduced in the American schools. The state of Kentucky has enlisted David Thornburg's help to propel their state into the Information Age and bring the whole state online through the World Wide Web. The need is for teachers to be not only aware of the Internet, but surfers and world-gatherers of relevant information to excite, encourage, and empower their students into the twenty-first century and beyond.

A humorous chart was made by Elliot Maise called "The Four Stages of User Development." The four stages are:

1. Unconsciously incompetent
2. Consciously incompetent
3. Consciously competent
4. Unconsciously competent

The Profile of the At-Risk Teacher

1. Has no perceived need to learn technology
2. Sees the subject area as too difficult
3. Doesn't work well in groups
4. Rebels against authority figures who tell them what they have to learn
5. Fears equipment failure and also feels insecure at the thought of fixing it
6. Fears the students will already know more than they do
7. Fears they will be giving up part of the curriculum to use technology in the classroom

What can we do to change the attitude of these teachers?

Step One

- Create an At-Risk comfort zone
- Maybe slip in a fun game to play

- Show them that technology can be an administrative tool to ease the daily grind
- Establish a resource bank
- Set up dialog with teachers to assess their needs Be a great role model
- Provide release time to develop lesson plans Provide one-on-one time with the tech guru
- Break into a new program together and make it dance

Step Two

- Encourage teachers who begin to use computers
- Provide a good grading program
- Give them a relatively easy-to-use word processing program
- Employ easy-to-use software that makes the computer seem easy and that allows them to see applications in their subject area
- Team up teachers and encourage them to integrate curriculum

Step Three

- Be the trainer/corner person ... when the teacher needs assistance, be there for him or her; take those phone calls at night
- Let them get confused!
- Inservice ... Tutor ... Inservice ... Tutor: Take time and show them some magic!
- Prepare a razzle-dazzle presentation, multimedia interactive lesson plans, and maybe a WAC attack
- Knock on doors
- Convert the willing
- Recruit your replacement

Step Four

- Give maximum support to those who get hooked Team up the transformed teachers and blitz the staff with some top-notch integrated instructional presentations
- Evangelize the lost
- Get those students you have brought along to help the teachers see the light

The Information Age is here, and the need for teachers to embrace it is clear. We need to demonstrate curriculum that has technology-embedded skills that will encourage and motivate those At-Risk teachers to excel. We need to take time and create cohorts to bring the education system up to speed and merge onto the information highway. We need to encourage one another and be the active learning role models that motivate students to be an active part of their future.

Paper

A Computer Curriculum Guideline for Junior High Schools in Taiwan: Its Impacts and Issues

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Key Words: **computer curriculum, curriculum guideline, computer education policy, computer education**

Abstract

A computer curriculum guideline for Taiwan junior high schools was announced in 1994 and will be nationally implemented in 1998. Due to the specific educational system in Taiwan, the guideline will affect computer textbook writing, computer teaching and learning, computer teachers' professional development, and computer education researches. This paper is to introduce the guideline, discuss its impacts, and describe issues. We believe that a mandatory curriculum guideline or standard is necessary for providing computer concepts and skills to all our next generations. A solid computer education research base should be established to provide usable and promising perspectives and strategies for computer education practices.

Introduction

The first official computer curriculum guideline for junior high schools (7th, 8th, and 9th grades) in Taiwan's educational history was announced (Ministry of Education 1994). It will be implemented at every junior high school in the 1998 academic year. The interim four years from 1994 to 1998 is for preparing teaching and learning materials, providing professional development to teachers, and installing hardware and software. The term "Computer" was selected as the subject/course title. The Computer course is required for all junior high students. The guideline is a symbol of the powerful influence of information technology on educational policy. It is predictable that the guideline will have powerful impact on the existing educational practices. This paper is to describe the contents of the guideline, discuss the possible impacts, describe some supporting programs, and consider the rationale of "computer as an independent subject."

The Curriculum Guideline

The guideline includes goals, content outlines, time allotments, textbook writing principles, teaching principles, and assessment principles. Among them, the content outlines and the textbook writing principles have more critical influence on the curriculum implementation. They are described below.

Content Outlines

There are twelve units, each has its own specified periods (one period is 45 minutes). The numbers in the parentheses are the allotted periods.

1. Human and computers (2): the roles of computers in everyday life, the influences of computers on society.
2. Basic hardware and software (4–6): basic terms, basic operations of hardware and operating system.
3. Word processing (6–8): Chinese character keyboarding and printing, basic operations of word processing software, everyday general applications.
4. Concepts of application software (2): concepts and software demonstration.
5. Operating environments (4–6): basic structure of computer systems, introduction to operating environments, such as the *Microsoft Windows* environment and Chinese environment.
6. Computer graphics (6–8): basic operations of graphics software, everyday general applications.
7. Computer ethics (2): intelligent property right, copyright, privacy, confidentiality, security.
8. Programming languages (4–6): concepts of languages, demonstrations of program examples.
9. Information management (6–8): concepts of database, basic operations, everyday general applications.
10. Trends of computer evolution (2): the future of computer hardware and software.
11. Multimedia (4–6): concepts of multimedia, basic operations, demos.
12. Networking and communications (6–8): concepts of networking, e-mail, file transfer, bulletin board, local area network, wide area network.

Units 1 to 6 consist of the first volume, and units 7 to 12 consist of the second volume. Writers and publishers have to follow the topics outlined in the guideline. In principle, local schools will be required to arrange the four-credits course in eighth and ninth grades with one credit per semester, but local schools can also adjust the course to be a two credits per semester course in eighth grade.

Textbook Writing Principles

There are eleven principles listed in the guideline requiring or recommending that the writers and publishers follow. The following are six of the main principles:

1. Teacher's guide: A teacher's guide is required to accompany the textbook. A student guide is optional.
2. Exercises: Exercises must be integrated into the textbook.
3. Demo disks: This is optional, but the publishers are encouraged to include demo disks into the textbook.
4. Appendix: It is recommended that new and updated materials be appended in the textbook.
5. Everyday examples: Textbook should use everyday and student understandable examples to explain the concepts and applications of computers.
6. Positive words: Negative words, phrases, and sentences should be avoided.

Although the textbook writing principles are loosely stated in the guideline, these principles will be used to evaluate the candidate textbooks. Writers and publishers will be forced to follow the principles carefully.

This national computer curriculum is a result of more than ten-year effort in exploring the possible ways to introduce computer concepts and information technology to every citizen. The establishment of an independent computer subject ends the confusion and mixture between computer science education and computer-assisted instruction, a mixture usually misleads teachers to think a computer-assisted instruction training is a computer science education training.

Characteristics of the Guideline

Application oriented—Word processing, computer graphics, information management, multimedia, and networking are very application-oriented topics.

Literacy-oriented—Only basic computer concepts and basic skills are emphasized. Programming is not a required skills for junior high students.

Hands-on oriented—The time allotment for each unit of word processing, computer graphics, information management, and networking/communications are six to eight periods respectively to give students enough time to practice practical applications.

Hardware/software independent—No specific hardware or software is listed in the guideline for the purpose of keeping the curriculum flexible and adaptive to new hardware and new software.

Civic education emphasized—The computer ethics unit is a mark of the intention to enculture the future adults with ethical judgment. It is a kind of civic or citizenship education. We believe that it is very necessary to have this unit in the curriculum to indicate the importance of computer ethical issues.

If we believe that computer education includes computer literacy education, computer application education, computer technology education, computer engineering education, and computer science education, then the computer curriculum guideline for Taiwan junior high schools must include both computer literacy education and computer application education.

The Possible Impacts

Impact on Computer Market

Computer education as a required education in junior high schools will open a new billion-Taiwan-dollar market. For the past 17 years (since the birth of the Apple II in 1978), Taiwan educational authorities have been upgrading computers from Apple II, to PC/8088, 80286, 80386, 80486, and now to Pentium PC. In the past, the hardware upgrading was not a nation-wide movement and its impact on computer market was not significant. Under the new computer curriculum guideline, every junior high has to set up at least one computer lab equipped with at least 80486 PC and a local area network. The impact on the computer market will be very significant.

Impact on the Demand/Supply of Computer Science Teachers

More qualified computer teachers are needed in junior high schools. The demands will attract some college computer science majors to take necessary teacher qualification courses for those hoping to be junior high school computer science teachers. This is a positive impact. Currently, there are 33 computer science departments in universities and colleges as of 1993 (Ministry of Education 1994). Therefore, the amount of the supply of qualified computer science teachers will not be a problem.

Impact on the Computer Textbook Writing and Publishing

Computer textbooks should pass the evaluation procedure before they are qualified to be candidates for school textbook selection. The writers and the publishers will be driven by the curriculum guideline. This situation will be helpful for enhancing textbook quality through the publishers' competition to pass the evaluation.

Impact on Students

Junior high students will have one more required course which will affect their time scheduling. If the computer education course is not properly arranged, students will be given extra learning burdens. Currently, the national curriculum for junior high school students has more than 15 subject areas. The main subjects are: Chinese, English (American English), math, history, geography, physics and chemistry, earth science, and biology. These main subjects are very dominate due to the high school entrance examination system. Computers, as a new subject, will affect students' time arrangement.

Impact on Parents

Some parents' anxiety is expected because some of them might feel it is necessary to buy computers and related software to support their children's learning about computers. Some parents might feel their children will be far behind others if their children do not own their own computers. Under this psychological climate, the curriculum becomes a double-edged sword which has the risk to spoil the educational equality because of the gap between the haves and the have-nots.

Impact on School Management

Space, budget, maintenance, and the scheduling of computer labs will impose an extra burden onto the school management system. One of the risks is that the existing school administrators may not be familiar with the current computer technology and their anxiety toward computers might have negative influence.

To know these impacts in advance and to lessen possible negative impacts before the curriculum is implemented will be a very important task for both the central and the local educational authorities.

Rationale of "Computer as an Independent Subject"

One debatable issue is, "Why is it necessary to have an independent computer subject in junior high schools?" The advocation of computer science as a discipline in colleges is highly acceptable (Denning etc., 1989; ACM/IEEE Joint Curriculum Task Force 1991). The computer science curriculum in high schools is also favorable (ACM Task Force of the Pre-college Committee 1993a, 1993b). But "computer as an independent subject" in junior high schools is a very new and not-so-certain educational policy.

One of the most important reasons that supports computer education as an independent course is to provide equal opportunity of education, that is, to provide the equal opportunity of computer access. The argument is that the financial situations among counties and cities are quite different and it is not educationally fair to let the students in the poorer counties or cities, such as remote and geographically isolated islands and the rural areas, be left far behind the opportunity of accessing information technology which are considered as the fundamental technology for surviving in the existing and the future information society.

But "why don't we integrate computer technology and its related concepts and skills into the existing curricula?" During the past two decades, scholars have been promoting the ideas of integrating the computer technology into the existing subjects. The salient example is computer-assisted instruction. But the movement of integrating computer technology into existing curriculum is not successful, and the conventional computer-assisted instruction strategies were not very practical and helpful. If we admit that computer technology is very important to our next generation and the national and local economical and social productivity, some alternatives should be taken to promote the computer literacy and computer application skills to homes, schools, and workplaces. Establishing a required course in compulsory education is one of the practical and efficient alternatives.

"What are the potential benefits of having an independent and required computer education in junior high schools?" One of the potential benefits is that many low social economic status students have the guaranteed opportunities to access new and advanced computer hardware and software. For example, students can navigate world wide web sites on the Internet. Another potential benefit is that the computer devices in every junior high school will provide the necessary backbone for constructing distance learning programs through computer-mediated networking. For instance, a network-based distance learning program might be established to provide junior high school teachers the professional development opportunity. It is assumed that an independent computer education will induce many important marginal benefits.

Basically and fundamentally, education is an assumption-based enterprise. Each educational policy and its related implementation should have educationally sound assumptions. Computer education, as a new field with rapidly changing character, is not exceptional.

Supporting Programs

For accomplishing the implementation of the curriculum guideline, new programs were created, and some existing programs were updated and reinforced.

Computer Equipment Requirement for Junior High Schools

This requirement is a regulation by the Ministry of Education to enforce the schools to buy qualified hardware and software. The requirement regulates that government-granted elementary, junior high, and high schools have to follow the minimum requirements in purchasing computer equipment. The governmental financial support for schools to set up computer labs will be accomplished before 1998.

In-Service Computer Training Program

The in-service computer training for junior high school teachers have been executing for nearly ten years. For supporting the implementation of the first-time ever computer curriculum guideline, the in-service training programs were expanded to recruit more teachers to participate the training.

In-Service Computer-Assisted Instruction Program

This program is not directly related to the teaching of computer subject, but it was considered that it is important to create an all-around climate in schools in order to alleviate the possible resistance to the implementation of computer education as a subject. This is a very thoughtful consideration. The in-service computer-assisted instruction program has been existed for almost ten years.

Research Program of Computer Science Education

This is the first research program officially initiated by the National Science Council. The position paper announced by the Science Education Division of the National Science Council (NSC 1994) indicated four research directions. They are: (1) research on the cultural, social, economical, political, and technological background of computer science education, (2) research on the current state of computer science education, (3) research on the computer science teacher education and in-service professional development, and (4) research on the teaching and learning issues in computer science education. Currently there are several computer science education research projects supported by the NSC Science Education Division.

Networking Program

Junior high schools can connect to a nearby universities or colleges which have direct TANet (Taiwan Academic Network) and Internet connections. According to the Internet Society's data (Internet Society 1995, data is available at http://www.nw.com/). As of January 1995, Taiwan already had 14,168 hosts with the growth rate of 1,710% for the past three years, and Taiwan is the top 27th in domain size around the world. This data indicated that network will play an important role in the future Taiwan educational movements. Parts of Taiwan NII (National Information Infrastructure) optical fiber backbone are under testing in the hope of providing distance learning opportunity for teachers and students.

Issues

The transformational process of the computer curriculum guideline into the textbooks and then into the computer teaching and learning practices will not be a simple and linear task. There will have issues, some were discussed here.

Underlying Rationale Issue

The educational rationales/assumptions underlying the computer curriculum guideline are difficult to be presented clearly onto the content outlines. By reading the content outlines of the curriculum guideline, textbook writers and computer teachers may not catch the underlying educational rationales. Any implementation without enough understanding of the underlying rationales will have risks of wrong doing. For all students, literacy oriented, hands-on, motivational, concept oriented, not knowledge oriented, exploration, and others are the underlying rationales.

Operation-Oriented Issue

An application-oriented and hands-on oriented curriculum has the risk of misleading the textbook writers and computer teachers to emphasize too much on operational techniques.

Hardware/Software Upgrading Issue

Although every junior high school will have a well-equipped computer lab and networking, the life cycles of computer hardware and software are pretty short. Learners' needs are changing rapidly. Upgrading will be a serious issue.

In-Service Professional Development Issue

Many applications are technology-dependent (hardware-dependent, software-dependent), computer teachers need to learn new concepts and skills in order to teach their students. The in-service professional development program is definitely necessary, but budget will be an issue.

Textbook Evaluation Issue

The textbook writing principles listed in the guideline are too loose. How to establish a quality textbook evaluation procedure is an urgent event.

Learning Rationale Issue

Learning rationales like constructionism (Harel & Papert 1991; Harel & Papert 1991) and community of learners (Brown & Campione 1994; Brown & Duguid 1993; Lave & Wenger 1991) are usable for computer education in junior high schools. The curriculum guideline does not mention any learning rationale. How to integrate learning rationales into computer teaching and learning is an important issue. Constructing specific and integrated learning theories and formulating a framework for computer teaching and learning is necessary.

Effectiveness Issue

Effectiveness is always an educational issue, it is also a political and societal issue. The short life cycle of computer will hinder the gaining of high teaching and learning effectiveness in such a short period of time. How to evaluate the effectiveness of computer education in junior high schools will become a critical issue. Conventional learning issues, such as inert knowledge, decontextualized learning tasks, and others, will also appear in computer education area.

Conclusions

A curriculum is an indicator of educational policy, a guideline for textbook development, a tool for maintaining educational equality, and a bridge between educational policy and educational practices. The computer curriculum guideline for Taiwan junior high schools marks the beginning of a new educational movement for the becoming digitized information age.

Computer knowledge and skills are evolving rapidly. A computer curriculum guideline will have difficulty in keeping its pace with the evolution. Computer education researchers should try to define their research areas, know their research issues, and do authentic researches in order to lead the computer education. We believe that computer learning, computer teaching, computer teacher's professional development, computer curriculum, and computer education policy are potential research areas.

A curriculum guideline can be seen as a web that has many links to educational issues. Navigating the web will lead us to see the larger network which could present a more complete picture. Looking through the computer curriculum lens can bring us to a new and potential educational field which attracts us to cultivate the fundamental computer learning issues in order to establish the computer education research area.

References

ACM Task Force of the Pre-college Committee (1993a). ACM model high school computer science curriculum, The Computing Teacher, October, 24–27.

ACM Task Force of the Pre-college Committee (1993b). ACM model high school computer science curriculum, Communications of The ACM, May, 36(5), 87–90.

ACM/IEEE Joint Curriculum Task Force (1991). Computing curriculum, Communications of the ACM, June, 34(6), 69–84.

Brown, A. & Campione, J. C. (1994). Guided discovery in a community of learners, in K. McGilly (Ed.). Classroom lessons: Integrating cognitive theory and classroom practice, MIT press.

Brown, J. S. & Duguid, P. (1993). Stolen knowledge, Educational Technology, March, 10–15.

Denning, P. J. Comer, D. E. Gries, D. Mulder, M. C. Tucker, A. Turner, A. J. Young, P. R. (1988). Computing as a discipline, Communications of the ACM, January, 32(1), 9–23.

Harel, I. & Papert, S. (1991) (Eds.). Constructionism, Norwood, New Jersey: Ablex Publishing.

Lave, J. & Wenger, E. (1991). Situated learning: Legitimate peripheral participation, Cambridge University Press.

Ministry of Education (1994). The current state of computer education in Taiwan, The Computer Center, Ministry of Education (in Chinese).

NSC (1993). Research directions of computer science education, a position paper, National Science Council (NSC), Taiwan (in Chinese).

Papert, S. (1993). The children's machine: Rethinking school in the age of the computer, NY: Basic Books.

Paper

A Model Instructional Computing Course for Preservice Teachers

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Abstract

Foundations of Instructional Computing is a required one-semester, two credit course in the Education Department of Montana State University. This course offers students a foundation in learning to effectively integrate computers into their teaching. The following key components of the class are discussed: objectives, lecture, text, cooperative learning, software integration and evaluation, telecommunications, homework, tests, final project, assessment, and student evaluation.

Introduction

Technological changes are transforming society and the ways in which we learn. Teachers need to be computer literate and prepared to use the computer effectively in their teaching. Their computer use should be confident, thoughtful, and integrated into their teaching philosophies as well as their strategies. Teachers must know how and when to use the tools of computer technology to develop and expand their students' abilities. For these reasons, the education department of Montana State University made major modifications to the Foundations of Instructional Computing (EDCI320) course in 1991. Since then, continuous refinement and experimentation has taken place in this course every semester. Foundations of Instructional Computing course components include computer terminology, hardware selection, use of productivity tools, types of educational software, software evaluation and integration, telecommunications, use of hypermedia, computer ethics, and discussion of numerous computer technology issues related to education. The major objective of this course is to help preservice teachers develop use of computer technology that is confident, thoughtful, and integrated into one's teaching philosophy and strategies. The ISTE (International Society for Technology in Education) and NCATE (National Council for Accreditation of Teacher Education) guidelines for computer/technology competencies for all teachers are used as subobjectives for the course. These guidelines are as follows:

All candidates seeking initial certification or endorsements in teacher preparation programs should receive foundations that prepare them to:

1. demonstrate ability to operate a computer system in order to successfully use software.
2. evaluate and use computers and related technologies to support the instructional process.
3. apply current instructional principles, research and appropriate assessment practices to the use of computers and related technologies.
4. explore, evaluate, and use computer/technology-based materials, including applications, educational software, and associated documentation.
5. demonstrate knowledge of uses of computers for problem solving, data collection, information management, communications, presentation, and decision making.
6. design and develop student learning activities that integrate computing and technology for a variety of student grouping strategies and for diverse student populations.
7. evaluate, select, and integrate computer/technology based instruction in the curriculum of one's subject area(s) and/or grade levels.
8. demonstrate knowledge of uses of multimedia, hypermedia, and telecommunications to support instruction.
9. demonstrate skill in using productivity tools for professional and personal use, including word processing, database, spreadsheet, and print/graphics utilities.

10. demonstrate knowledge of equity, legal, and human issues of computing and technology use as they relate to society and model appropriate behaviors.
11. identify resources for staying current in applications of computing and related technologies in education.
12. use computer-based technologies to access information to enhance personal and professional productivity.
13. apply computer and related technologies to facilitate emerging roles of the learner and the educator (The ISTE Accreditation Committee, 1993, pp. 8–9)."

In addition, Foundations of Instructional Computing was designed to model the very same innovative teaching strategies that students are expected to use in their classroom and to model the integration of technology into instruction.

Lecture

Foundations of Instructional Computing was originally composed of a one hour lecture period once per week and a two hour lab once per week. The class has drastically improved by changing the course to meet for one three hour lecture/lab session per week. Students are able to spend more time in the lab than before, thus becoming more confident in using the various technologies. Student comments indicate that they prefer the lecture being incorporated into the lab because they like being able to immediately transfer knowledge from the lecture into hands-on activities in the lab.

Lectures have been incorporated as a part of the lab experience and have been reduced to as little time as possible. Electronic presentations are used during lecture so that the students have visual as well as auditory input. Each lab instructor is encouraged to ask questions to stimulate discussions during the lecture to facilitate constructive learning. Students are also encouraged to take notes using word processing software.

A few of the lectures (e.g. teaching and learning theory, test creation, and telecommunications) have been incorporated into *HyperCard* stacks. This provides a radically different way for the students to learn the material and reduces intellectual passivity and linear thinking, common problems associated with the traditional lecture method of teaching. The students later learn *HyperCard* basics themselves and use *HyperCard* to design a piece of educational software that will be incorporated into their final unit.

Text

Student dissatisfaction with the several different texts that have been used with EDCI320 has led to a new strategy for gathering and disseminating necessary information. Instead of using a set text, a variety of texts are put on reserve in the library, and each student has readings on a particular topic. Each student is responsible for reading his/her material, gleaning the most important points, and then being the guest teacher who will teach the information to the remainder of the class. Students are encouraged to use creative teaching strategies. If students decide to use lecture as their teaching strategy, they are encouraged to use *ClarisWorks* Word Processing slide show or *PowerPoint* for creating presentations to use with the lecture. Variations of use of having the students teach the information in the past have revealed that students must be limited to a short presentation (five minutes is currently being tried) and must be instructed to only teach the most important and relevant parts. Otherwise, some students tend to make their presentations too long and complex. In order to incorporate technology into this exercise, each student is required to learn to use *ClarisWorks* Draw to create an attractive newsletter complete with columns and graphics. The contents of the newsletter is the important information gleaned from the reading assignment. The student then distributes the newsletter during his/her presentation, and it can be used as a study guide for tests.

Students in EDCI320 are also required to review available computer magazines, such as *Learning and Leading With Technology* (ISTE Journal of Educational Technology Practice and Policy), *Connections, Journal of Research on Computing in Education, T.H.E.* (Technological Horizons in Education Journal), and *Technology and Learning*. They must then select an article of interest to themselves and to their classmates and give a short presentation on what they have learned. This is an excellent opportunity for both the students and instructors to share the most recent instructional technological news. In addition, students become familiar with some of the journals that will keep them, as teachers, technologically current. If limited class time prevents oral reports, then the highlights of the journal articles could be placed in a class newsgroup on the university network, thus giving additional experience in using the network while creating interesting reading.

Cooperative Learning

Cooperative learning is used to replace and/or supplement certain lectures. Cooperative learning gives students a more active, analytical role and encourages them to take responsibility for their own learning. Instead of sitting passively at their desks taking notes during lecture, the students are able to spend time thinking, synthesizing information, and applying ideas.

During the piracy/ethics/copyright portion students are placed in cooperative groups to discuss ethical dilemmas common to teachers using technology. Discussion is usually fervent and inevitably leads to the students convincing each other, with little instructor intervention, that teachers must practice ethical procedures regarding piracy, copyright violation, etc.

A cooperative group activity is also used to demonstrate the use of stations in a classroom. Sending e-mail, subscribing and posting to newsgroups, using a modem, and using Apple IIes is taught simultaneously using cooperative groups. Groups rotate through stations working together to make sure that each member of the group understands the concepts or skills at each station. Variations of this teaching model are discussed so students understand that even with one computer in a classroom there are many teaching/learning situations that can take place.

Students also work in groups of two or three on a computer to perform creative thinking activities, to learn various pieces of software, and to design and produce materials. Each student is usually assigned a responsibility, with one student (the reporter) inputting the information on the keyboard, one student (the encourager) making sure each person is participating and receiving encouragement, and one student (the checker) making sure that each team member understands what is being discussed and accomplished (Johnson, Johnson, & Smith, 1991, pp. 3:3–3:6). One of the student's favorite cooperative activities is the introduction to divergent thinking and database relationships. Each student group lists three nouns using word processing. Next, each group decides in what way each of the three nouns are like a piece of toast. This leads to a discussion of divergent versus convergent thinking and to a discussion about how data in a database can be categorized or related.

Software Integration and Evaluation

One of the most important elements of Foundations of Instructional Computing is software evaluation. Three weeks are used for exploring and learning about software and software evaluation, while all other topics are usually limited to one week. Exposure to as many different types of software as possible is emphasized, especially since once these students become teachers or return to the classroom, far too little time is available for good software evaluation and reflection on its use in the curriculum.

Students work in groups or individually and are encouraged to evaluate software in their own area. They use evaluation sheets actually used in the local schools so that the experience is more meaningful. They are encouraged to find software that will fit into their final unit, which focuses on a topic in their own area of study and that will be useful to them when they are actually teaching. In order to assure that the students evaluate all major types of computer-assisted instruction software and that they use it to the greatest advantage, they are given the following directions:

1. Use a piece of drill and practice software to refresh some skill you previously learned. Analyze the program to see if any of the following elements are given consideration: speed can be adjusted, operation is easily learned, positive reinforcement is more effective than negative reinforcement, content is accurate.
2. Use a tutorial to learn something new. Write a short description of the program including your likes and dislikes and a specific example of how you could use it in the classroom. How could it be improved? A brief list of characteristics is given so students know what to look for in judging the performance:
    - Does it have a clear objective?
    - Does the program allow students to redo missed answers?
    - Does it provide motivation to learn?
    - Does it provide feedback on the student's performance?
3. Evaluate a problem-solving software, a simulation software, and a CD-ROM (the CD-ROM can be any type). Use the form used in the local schools to evaluate the software.

Material from other classes taught in the Education Department is incorporated into the software evaluation portion of the class. Students must incorporate reviewed software into lesson plans that follow the lesson plan format learned in methods classes. They integrate their knowledge of Bloom's taxonomy, learned in Educational Psychology, into writing objectives for the lesson plans. They integrate their knowledge of Piaget's developmental stages, learned in Educational Psychology, into learning how instructional software can be used employing different strategies to reach students at different developmental stages. This particular concept is taught using *Building Perspectives*, a problem-solving piece of software. Using *Building Perspectives*, students look at nine high-rise buildings from an aerial view, front view, right view, left view, and back view. They must determine how many floors there are in each of the nine high-rise buildings. Some students try doing the exercise with no physical help, while some are given building blocks so they can physically create the buildings while looking at the different views. After the students have used this piece of software with and without building blocks, they see how a teacher can use manipulatives to bring an abstract concept to a more concrete level if needed. Students also use their knowledge of different learning styles, learned in Educational Psychology, to study how different teaching strategies can be used with a piece of software so that it is effective with students with different learning styles. As a part of this exercise, students are required to complete the "MAX Inventory of Learning Styles" on the computer. Each student is asked to bring a printout of his/her "brain," which rates how he/she scored on each of the learning styles designed by Howard Gardner. This exercise clarifies for the students how different each person can be and how important it is for teachers to use a variety of teaching strategies with a variety of software so that all students can effectively learn.

Telecommunications

The university telecommunications network is a technology that has provided a much needed aspect of EDCI320. Students must set up an account and send a message to their lab instructor describing an idea they would use in their own classroom using telecommunications. During the course students are encouraged to provide input to their lab instructors using e-mail.

In addition, the class has established its own newsgroup, where both students and instructors can post class announcements, discuss thought-provoking questions, and reflect on the effectiveness of teaching strategies used. When a teacher or student posts a message to the newsgroup, the message is listed in the newsgroup for all subscribers to see and to respond to with their own comments.

The class also uses *Netscape* software to access the World Wide Web. Students are easily motivated to use *Netscape* because it is easy to use and they love the colorful graphics. Students must locate lesson plans and/or information that they could use in their own classrooms in the future and that they can use in their final project.

Homework

Homework provides an excellent opportunity for incorporating the use of technology. Students must do all their homework using a computer. They must keep copies of all homework on an original disk and a backup disk so that no questions arise as to whether the student has done all the work if a homework is accidentally not recorded. Students can redo many of the assignments, which assures that they have every opportunity to properly learn to use the technology (e.g. *ClarisWorks* Word Processing, *ClarisWorks* Spreadsheet, *ClarisWorks* Database, *ClarisWorks* Draw, *MakeTest*, *SuperPaint*, and the World Wide Web) and have an understanding of the educational issues. Saving the work on a disk makes it wonderfully simple for the student to redo the work to make it right. Students also keep records of their own homework and test scores in a spreadsheet so they can track their grades.

Tests

A technology Bingo game is played as a review the week before the test. Bingo software is used to create Bingo boards that contain technology questions that might appear on the test. Each class member is given a Bingo board and must circulate around the classroom having other students answer the questions. The student who knows the answer must explain it fully and then sign his/her name in the bingo square containing that question. The first student who has a total blackout receives a free disk. Even college students find this exercise exciting, so this portion of class is always extremely lively.

Tests are used to reinforce student technology skills and knowledge, plus innovative strategies are used to ensure the students learn the answers to the questions they missed. Quizzes and the essay portion of tests must be done on the word processor. Essay answers must be free of spelling errors (since spell-check can be used), and the students demonstrate their mastery of using the lab printers when they print. After the students have received their graded papers, they can research the correct answer and use the word processor to write full paragraphs discussing the answers to true-false, multiple choice, and fill-in questions in order to recoup half the points they missed. This assures that they learn information vital to using computers in the classroom. An alternative testing method that has been tried in this class is allowing small groups to take the first part of the test (true-false, multiple-choice, fill-in) and requiring each individual to do the essay portion alone. If students are not happy with the group score, they can individually research each missed question and write up the answers to recoup the missed points.

Final Project

All in-class work and out-of-class assignments lead toward the creation of a final project that ties together all the students have learned. Students select a unit topic that they will be able to actually use in their classroom in the future. They then create a portfolio of all the portions of that unit that relate to computers. Following is a list of what currently must be included in the final unit:

- a sign or poster created using *PrintShop* or *SuperPaint* to introduce the unit (this must list the main unit objectives).
- a lesson plan describing how they plan to incorporate their *HyperCard* stack they created.
- a second lesson plan incorporating the piece of CAI software they plan to use in their unit.
- a completed evaluation form evaluating the piece of software in the preceding lesson plan.
- a newsletter that could be used as a study guide to reinforce the objectives of the unit.
- a printout of a relevant lesson plan or other information that was retrieved using the World Wide Web.
- a description of an activity that uses a spreadsheet or database as a teaching device for the selected subject matter and a sample of the completed spreadsheet or database.
- a test created using *MakeTest* that would be used to test learning of the objectives of the unit.
- a mail merged letter to the parents of several students in the class describing the unit and what the teacher expects of the student.
- a printout from a piece of tool software used to enhance the unit (e.g. crossword puzzle, certificate, etc.).

Assessment

Student assessment is based upon quiz and test grades, quality of lab assignments, participation in group activities, the oral report on the student's journal articles, quality of the student's guest teaching of his/her assigned chapters to the class, and quality of the final unit project. Each activity is assigned point values. These point values are then used to compute the students' final grades.

Student Evaluation of Course

During the last class session, students are asked to complete course evaluations. These evaluations are read and used to assist in determining changes to be made for the next semester's class.

Overall, the evaluations are extremely positive for this course. Students especially enjoy the hands-on lab activities. Students comment continually on how relevant and important the material is to them as future teachers. Since the instructors also believe in the relevance and importance of the material and this is reflected in their teaching, the students are continually commenting on the enthusiasm of the instructors.

Evaluations of the particular class format described in this paper revealed that students preferred to return to regular text reading assignments. Many students felt that the time allocated for students to "guest teach" their assigned text chapters used too much valuable computer lab time, and they desired to return regular text readings. Students also requested that even more time be spent in the computer lab learning telecommunication skills, especially use of *Netscape* and the World Wide Web.

While graduating students are not officially interviewed to determine how this course has assisted them in their teaching, many graduates who have obtained teaching jobs do return to give the instructors input. The general returning graduate comments indicate that this class has proven to be one of their more valuable courses. Returning graduates iterate that they use the skills learned in this Foundations of Instructional Computing course frequently in their classrooms. Graduates often tell us that they particularly use newsletters in their classroom and are extremely happy that newsletters were covered in this course. A few graduates have informed us that they have become the technology coordinator of their school and that they directly attribute this to having taken this course.

Conclusion

For many teacher preparation programs, such as ours, only one basic instructional computing course is required. This is blatantly an inadequate technological preparation for future teachers with the current accelerating technological advances that are occurring. Each of us, therefore, must work constantly to improve these foundation courses. They must teach the basic survival information and provide a foundation for further life-long learning, while they must model the very things that they teach. Sharing how and what is taught in these classes is a beginning for making all of our classes even more stimulating and productive.

References

ISTE Accreditation Committee. (1993). *Curriculum Guidelines for Accreditation of Educational Computing and Technology Programs, 2nd Edition.* USA: International Society for Technology in Education.

Johnson, D.W., Johnson, Roger, T., & Smith, K.A. (1991). *Active Learning: Cooperation in the College Classroom.* Edina, MN: Interaction Book Co.

Focus

Project SIMULATE: A University/Elementary School Technology Collaboration

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Key Words: **computer, simulations, mathematics, science, elementary, university, collaboration**

Abstract

Project SIMULATE (Science Integrated with Mathematics Using Language Arts and Technology Education) was designed to enhance the technological and instructional competence of inservice and preservice elementary school teachers. Using multimedia simulations and language arts activities to teach science and mathematics, teachers are learning to guide students to discover the long-term relevance of their learning as they internalize concepts and processes. Preservice undergraduates and their mentor teachers are paired at a K–6 school where a field-based program for undergraduate education majors has been in place for five years. A 60-hour summer institute, including a family workshop, provided teams the multimedia and pedagogical knowledge to infuse technology into integrative classroom instruction.

Rationale

National reforms in mathematics and science education, as recommended in the standards of the National Council of Teachers of Mathematics (1989, 1991) and the National Science Education Standards (1994), indicate the need for students to prepare for the 21st Century by developing skills in problem solving, decision making, investigative inquiry, "real-world" applications, and justification of their solutions. Computer simulations appear an excellent match to this type of learning (Office of Technology, 1995). Unfortunately, many practicing teachers have neither the skills nor the equipment to model the use of technology for the education undergraduates they mentor. This is of particular concern, given that classroom modeling during student teaching influences the way graduates teach more than the instruction provided by university professors (Calderhead, 1988; Hoy & Woolfolk, 1989; Kagan, 1993). Participation by a critical mass of teachers on site is important to effective implementation (Office of Technology, 1995). Eighty percent (80%) of the teachers at the Project SIMULATE school are participating in the on-going inservice program. Providing staff development for both preservice and inservice teachers at one site offers two great advantages: efficient sharing of resources and optimal participant support.

Goals and Objectives

The goal of the project is to provide an exemplary preservice traineeship program which offers opportunity for future teachers to work collaboratively with their practicing mentors to develop and implement instruction designed around mathematics and science computer simulations.

The specific objectives are these:

1. To provide professional development for preservice teachers and their practicing, mentor teachers in using multimedia-based simulations for mathematics and science.
2. To assist preservice teachers and their practicing, mentor teachers in collaborative production of integrative units centered on multimedia-based simulations, thereby linking current technology and pedagogy.
3. To facilitate preservice and mentor teachers' application of multimedia-based instruction in their classrooms, developing children's skills in inquiry, investigation, problem-solving, and cooperative learning.

Structure of the Project

In a true collaboration model, leadership training and equipment are provided by both the university and the school district. Four of the professors on the project team are instructors for the field-based program at the public school site where the project is being implemented, and a university graduate assistant provides technological assistance; the director for instructional materials in the local district led the summer institute, and teachers from district serve as in-house coaches for technology questions. To facilitate the training and the actual teaching of technology within integrative thematic units, the university provides multimedia carts of equipment, and the local school and university share responsibility for providing software.

At follow-up meetings during the school year participants share their successes and address their concerns, questions, and insights for improving their use of technology to enhance instruction. The teaming of practicing teachers and university students is mutually beneficial, as it offers a healthy mix of differing experiential levels in technology and curriculum implementation.

Data Collection

Both quantitative and qualitative data are being collected and analyzed using multiple evaluation instruments: hands-on computer competency tests, questionnaires with both Likert-scale and open-ended items, interviews, classroom observations, journals, technology usage logs, instructional units, and student products. Preliminary findings indicate significant, positive results. Participants have increased in both their perceptions and actual demonstrations of computer skills. Inservice as well as preservice teachers have added new techniques to their instructional repertoires. Students are spending more time involved with programs that require higher order thinking strategies.

Conclusion

The results of the efforts expended in this project appear encouraging. As change agents, the inservice and preservice teachers participating have already begun to influence their peers, as well as the ultimate beneficiaries of improved instruction, K–6 children. This project, funded by an Eisenhower grant through the Arizona Board of Regents, offers the educational community four valuable components: a linkage of pedagogy and technology; collaborative planning to create instructional units; techniques to maximize the use of resources; and a simulation-based inquiry approach to stimulate students' higher order thinking skills.

References

Calderhead, J. (1988). The contribution of field experience to primary student teachers' professional learning. *Research in Education, 19,* 2–10.

Hoy, W. & Woolfolk, A. (1989). Supervising student teachers. In A. E. Woolfolk, ed. *Research Perspectives on the Graduate Education of Teachers*. Englewood Cliffs, NJ: Prentice-Hall.

Kagan, D. (1993). *Laura and Jim and What they Taught Me about the Gap between Educational Theory and Practice*. Albany, NY: State University of New York Press.

National Research Council (1994). *National science education standards (draft)*. Washington, DC: National Academy Press.

National Council of Teachers of Mathematics (1989, 1991*). Curriculum and evaluation standards for school mathematics*. Reston, VA: Author.

Office of Technology Assessment (1995*). Teachers and technology: Making the connection*. Washington, DC: Author.

Paper

The Internet as a Tool

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Key Words: **Internet, K–12, World Wide Web**

Being a teacher in the age of information is exciting. With the current technology, we have the opportunity to change the way we teach and how our students learn. But it is important that we use and teach our students how to use the Internet as one tool to help us all compete in an uncertain future.

One of the best analogies that addresses how schools have not used computers as a tool, is from a speech given by Doug Johnson, the Media and Technology Coordinator for the Mankato, Minnesota, public schools (*http://www.isd77.k12.mn.us/resources/dougwri/leg.talk.internet.html*).

In his speech, Doug describes a primitive tribe finding an abandoned car in the middle of a field. They may use the trunk of the car to store their belongings. They may honk the horn to scare away wild animals. They may sleep in the back seat to keep warm and dry. But until they see that car driving on a road they may never really understand the true potential of that car. The same situation has occurred in our schools with computers. We use them as fancy typewriters, as simulators, or as fancy workbooks for drill and practice. But, until we see that computer hooked up to a network or on the Internet we never quite realize the potential and true use of the computer as a tool to access information, to communicate and to collaborate.

There is a new trend where educators are finding exciting ways to use computers as tools to educate and to learn. Hillside Elementary School in Cottage Grove, MN is an example of that trend.

As a Medium for Student Publishing

One of the uses of the Internet by Hillside Elementary is to publish their students work. The Hillside students began their Internet publishing by creating home pages: (*http://hillside.coled.umn.edu/class1/class1.html*), (*http://hillside.coled.umn.edu/class2/class2.html*). The students used a drawing program to create a picture for their page and then wrote a paragraph telling about themselves. The home pages gave the students an opportunity to make a presence on the Internet.

Think back to the years when you were in elementary school and one of the first assignments your teacher gave you was to write a paragraph about yourself and share it with the class. Let's look at Max's experience with writing that same type of paragraph but instead publishing it on the Internet. Max wrote about his goals for the future. He explained that he would like to be a scientist and go to Stanford. Max received e-mail from students who attended Stanford University. They gave Max advice on working hard in school so that his grades would be good enough for him to be accepted into Stanford University. Max was able to ask the students questions about the University. He has set a goal for himself and now he knows some of the things that will be required for him to reach that goal. This student wrote his paragraph and shared it with the world: (*http://hillside.coled.umn.edu/class1/MaxDR1/home.html*).

There are other things that schools publish on the Internet. The Hillside students created a Choose Your Own Adventure story for the Internet. In the process of learning about story structure, characterization, and using descriptive phrases the students collaborated as a class and created *The Buzz Rod Story:* (*http://hillside.coled.umn.edu/class1/Buzz/Story.html*).

While the students created a setting for Buzz's adventure they found it was important to use some facts. Using an atlas the students chose the city Grand Rapids in Michigan. They put Buzz Rod in a candy apple red Dodge Viper with black interior and sent him cruising down I69. Buzz sees a bright light and loses control of his car. That is where the story's Random Space Time Warp button comes in handy. Just click on the button and you are randomly sent to one of the individual endings created by the students. The teacher who finds this page on the Internet is able to access the lesson information used by the teacher to teach the project: (*http://hillside.coled.umn.edu/class1/Buzz/teacher.html*).

As a Resource

There is also technical information for the teacher who wants to know how to create pages for their own classroom's Choose Your Own Adventure Story. The Internet is used in education to access resources, and conduct research. The students at Hillside completed research projects (*http://web66.coled.umn.edu/hillside/franklin/Projects.html*) by using resources from the Franklin Institute (*http://sln.fi.edu/*), NASA, the National Weather Service, Berkeley's Hall of Dinosaurs, and countless others.

The Web66 Collaborative Research Project gave students the opportunity to work on research skills while using the Internet as a tool. The students learned how to formulate good questions, research and organize information, find information using the World Wide Web, and create their own style of presentation. They accessed experts in the topic areas they were studying. The students made real life, real job, connections to the different topic areas they were exploring.

- Amanda, a sixth grade student, created a page on space. She used a clickable map to organize her information on Jupiter, the Moon, comets, and the Earth: (*http://web66.coled.umn.edu/hillside/franklin/space/Project.html*).
- Regie chose a different way to share his research project on the heart. He created hyperlinks throughout his paper for others to find in-depth information

on a specific section of his project:
(*http://web66.coled.umn.edu/hillside/franklin/heart/Project.html*)

- Ryan and Max gathered information from many sources on Natural Disasters. On their page you will find information on a specific topic like earthquakes plus a list of links to other people's pages that give more information. Ryan and Max created their own earthquake simulation movie based on a lesson plan they found on the Internet:
(*http://web66.coled.umn.edu/hillside/franklin/disaster/Project.html*).

After the students placed their research projects on the Internet they received feedback from people around the world. Their projects became a beginning for further investigations and mentorships with others.

As a Communications Teaching Tool

The Internet is a valuable tool for teaching students to communicate with people they may not have access to without the Internet. The Hillside students used the Internet to communicate with survivors of World War II, using the Memories Listserv, while learning about historical fiction: (*http://www.tcns.co.uk/chatback/memories.html*). The students read novels about World War II. They kept journals about the characters lives. They accessed nonfiction materials about World War II to gather in-depth information about certain times and events they were reading about. The students used atlases to chart the different places the characters were located. Students had the opportunity to ask questions and interview the different panel members of the memories list.

The Hillside students were able to use the memories of the survivors of W.W.II to create their own historical fiction stories. While writing the stories the students were able to make the connection between historical fiction and real historical facts: (*http://hillside.coled.umn.edu/1994-1995/ww2/historical.html*).

Projects like this one are greatly enhanced by using the Internet as a tool to communicate with people that are experts in the topic area the students are studying.

As a Collaborative Tool

One of the most powerful uses of the Internet in education is to collaborate with others. Teachers can collaborate with other teachers. Students collaborate with other students. Experts and educators all over the world become collaborators with the teachers and the students in a classroom. No longer is distance and time a barrier for educational collaborations.

The Franklin Institute's *Wind Project*: (*http://sln.fi.edu/tfi/units/energy/wind.html*) is an excellent example of how collaboration through the Internet can be a powerful tool in the classroom. Using the Franklin Institute as a mentor and a resource, a group of six schools worked together to learn about wind. The schools used the World Wide Web to publish the students work so that each school could view the projects created by students from the other collaborating schools:
(*http://hillside.coled.umn.edu/Wind/Wind.html*).

The students began by writing Windy Inspirations. This activity gave students the opportunity to connect wind to previous experiences that they may have had. The students also had the opportunity to see other's wind experiences. They conducted wind experiments by using different materials to measure and observe wind. Throughout this investigating, the students were able to communicate with other students from other schools. The students at Hillside Elementary drew on the experiments conducted by Captain Strong Elementary students using pinwheels (*http://152.157.16.3/doc/salmon/wind*). The students used the pinwheel observations when creating their own windmill blades. They also created wind projects that were shared through the use of the World Wide Web and CU-SeeMe.

Hillside Elementary shared their wind experiences by making a wind movie that could be accessed over the Internet (*ftp://weblink.coled.umn.edu/Wind.mov*), and concluded their part of the wind project by hosting an Internet fair. The students shared their projects and windmills with the community and the world using Cu-SeeMe (*http://hillside.coled.umn.edu/1994-95/Fair/Fair.html*).

Giving students the opportunity to collaborate is motivating for all of the students involved. The teachers have the opportunity to draw on each others ideas and to give their students a richer experience. The collaboration gave students access to six teachers instead of one.

Web66

Hillside Elementary is a pilot for the University of Minnesota Web66 project. Web66 is a resource that will help you to learn how to set up your own Internet server, to construct your own network, to find other K–12 educators and students using the Internet, and to find and use educational resources on the World Wide Web. Web66 has a comprehensive Registry of K–12 schools (*http://web66.coled.umn.edu/schools.html*) on the World Wide Web that is a great resource for locating information about possible collaborating schools from around the world.

The Web66 What's New Pages (*http://web66.coled.umn.edu/new/new.html*) are where you will find current links that are of interest to K–12 educators and students. Using the Web66 What's New Pages will help you to stay current with the rapidly growing World Wide Web education resources.

- The Web66 Classroom Internet Server Cookbook (*http://web66.coled.umn.edu/Cookbook/contents.html*) gives the educator step by step instructions for setting up a WWW, Mail, and FTP server using a Macintosh computer or *Windows 95*. The cookbook provides links to the software (ingredients) that you need to create each of the classroom servers.
- Using the Web66 Network Construction Set (*http://web66.coled.umn.edu/Construction/Construction.html*) helps the educator to identify and understand the different parts of a school network.
- Joining the Web66 Mailing List (*http://web66.coled.umn.edu/List/List.html*) gives the educator access to other educators who are using a World Wide Web server in their classroom.

The Web66 project provides teachers with the vehicle (Mustang) to cruise down Web66 on the World Wide Web. Web66 teachers cruise the web with the style of the '67 Mustang, deciding when to travel, which direction to travel, and how far to travel. Web66 teachers are in full control of their own destiny and can seek out the best educational destinations anywhere on the web (*http://mustang.coled.umn.edu/*).

By using Mustang, educators will have a management model for integrating the World Wide Web into their curriculum. They will design and implement Internet projects that meet their curriculum goals and graduation standards. Educators will have access to an online staff development program that will provide models and support. The Mustang also takes educators on a virtual Internet trip. Using the analogy of the Internet being a highway, Mustang takes educators through three stages of project design:

- Preparing to Travel
- Taking the Trip
- Returning to Home

In preparation for the trip, the educators need to know what possibilities are available and how they can proceed. Educators:

- "visit the online travel agent" and find examples of how the Internet is used to teach and to learn and the basis for that learning (*http://mustang.coled.umn.edu/howused.html*).
- "service their vehicles" and discover examples of acceptable-use policies, permission-to-publish forms, and state graduation standards (*http://mustang.coled.umn.edu/Started/Started.html*).
- "select some destinations" using the "select your destinations" link that provides a selection of jump pages divided by subject areas to give the educator a guided tour of the Internet in the K–12 setting (*http://mustang.coled.umn.edu/Exploration/Exploration.html*).
- "plan a route" (*http://mustang.coled.umn.edu/plan.html*) by viewing the example of an Internet project design under the "plan the routes" link. Implementation of an Internet project can be found under the "hit the road" link (*http://mustang.coled.umn.edu/Hit.html*).

Once the educator has taken their Internet trip, she or he will need to return home and unpack the gathered "loot." In this section of Mustang, educators can find an example of how a teacher would/could/should evaluate a final Internet project (**http://mustang.coled.umn.edu/loot.html**). Upon "returning home," educators can also view the published results of other educators' projects to possibly implement in their own classroom. This link is what Mustang terms the "slide show" (**http://mustang.coled.umn.edu/show.html**).

Conclusion

In 1994, the Web66 project began by putting Hillside Elementary School's Sixth Graders on the World Wide Web. At that time Hillside was the second elementary school in the world with a web server. Since that time, the number of K–12 web sites has steadily grown. It took fourteen months to get the first 500 school web sites in the Web66 International Registry of K–12 schools on the web. It took four months to get the next 500 school home pages up. It took two more months plus nine days to reach 1,500 schools. In the first three weeks of November 1995, 350 new school home pages were registered on Web66 (*http://web66.coled.umn.edu/schools/stats/stats.html*).

Today there are over 2,000 schools on the web. For our students to compete in the current global community, it is imperative that we as educators embrace and use this tool in our teaching. The Web66 project is a collaboration with the University of Minnesota College of Education & Human Development, the Center for Applied Research and Educational Improvement and the 3M Corporation.

Project
The Internet as a Collaborative Tool in the K–12 Classroom

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Key Words: World Wide Web, Internet, collaboration, K-12

The Internet has become a powerful tool for the K-12 Educator to communicate and to collaborate. As schools are connected to the Internet, they begin to form collaborations with other schools, corporations, and experts from around the world. These collaborations expand the classroom and give students the opportunity to apply their communication skills. The Web66, Hillside Elementary School, University of Minnesota College of Education & Human Development, the Center for Applied Research and Educational Improvement and the 3M Corporation have designed a model for student, teacher, and business collaboration. This innovative model has several components and some are described in the presentation.

This presentation highlights the project piloted by the Hillside Elementary School and the partners from schools, universities and businesses throughout the world. The presenters discuss the model used to initiate collaboration between students, teachers, administrators, universities, government agencies, museums and businesses.

The collaborative projects have given students the opportunity to develop a global understanding of community, work, economics, government, and culture. By cooperating with business, students form mentorships with people in jobs that interest the students. Those students experience an online apprenticeship.

In cooperation with the Department of Education in Hawaii, Hillside students have the opportunity to share their experiences about living in Minnesota and learn about life in Hawaii.

The Monterey Academy of Oceanographic Science in Monterey, California and a third grade class at Hillside have the opportunity to learn about the ocean and understand our economic dependency on the oceans of the world by using a collaborative approach.

These are just a few examples of how Hillside Elementary has formed collaborations with others throughout the world. Other examples of collaboration will be shared in the presentation.

Project
Preparing for the Age of the Image...Building a Computer Graphics Lab with No Budget

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Key Words: **animation, video, graphics, imaging, 3-D, high school, Bill Gates**

Preparing for the "Age of the Image" is a presentation which will highlight the emergence of a video and graphics computer lab at a Vermont high school. From the humble beginnings with a Video Toaster computer to the current state-of-the-art facility, this video enhanced presentation will address the growth of the lab through gifts, grants and the sale of student made materials. The "demo" tape of students work will be shown.

The interest generated by the success of the students encouraged the development of an academic course called "Electronic Arts." This course is now available for computer, art, and technical education credit. Because of over enrollment, many students select to do Independent Study projects to enrich their schedules. Some of these students now use the lab to develop demonstration videos for their college applications. Students have also gone on to become the teachers for the academic courses. It is truly an enlightened view to see students teaching teachers in courses for recertification. The students now offer diversified classes to the community and surrounding schools. These offerings, which are currently oversubscribed, continue to help support the facility.

The school system gives no money to the facility and all advances have been made with student generated initiatives. Kids have sold materials to local colleges and businesses. Recently their work has been seen nationally on NBC (Smithsonian "Cyclone" Special) and CNN (Model UN). Many other projects have been seen locally on broadcast and cable television stations. The reputation of the Lab has grown through the years so that now businesses and broadcast operations come to lab seeking help with their graphics problems. The lab continues to be self sustaining.

Another source for funding has included the winning of numerous grants. Grantors from such diversified sources as Pepsi and Resolution Video have made it possible to continue the work of the lab. Software manufactures have also made notable contributions after seeing student work. These include Alias/Wavefront ($93,000) and Autodesk Corporation ($9,000) among others. The Henderson Foundation has given a grant which has provided a Silicon Graphics workstation. This unit has made it possible for students to create on a platform which is currently used by Hollywood professionals.

Possibly the most significant grant, however, has been awarded this past year. Microsoft Corporation and Bill Gates have honored the lab with the prestigious *The Road Ahead* grant. Only 22 schools in the entire country have been given this award, which has enabled the lab to offer its services to many more students and adults. It will now be possible for this "student as teacher" model to provide service for the entire South Burlington community. Courses will be offered to teachers as an aid in the development of curriculum materials for their classes. Through the South Burlington Recreation Department, courses will be made available to members of the community. The South Burlington Police Department will sponsor a course for at-risk students in cooperation with our middle school after school program. The Road Ahead Grant, administrated by the National Foundation for the Improvement in Education, has made the efforts of all of the participants a worthwhile venture.

The plan for the future is simple–continue the past initiatives and secure as much funding as possible so this model might continue and flourish in this community and hopefully be replicated in many others.

Project
Creating University/School Partnerships: Everyone Wins!

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Key Words: **teacher education, professional development, partnerships**

This project describes the innovative design and implementation of partnerships between inservice and preservice teachers. The Instructional Computing Lab in the Education Department at Montana State University excels in working with teachers and principals to design creative partnerships in which everyone wins! The preservice teachers gain access to real life students and to master teachers while the inservice teachers gain in becoming more confident and comfortable in using computer technology to enhance learning in the classroom. Discussion includes: needs assessment, determining what each partner can offer to the partnership, designing the project,

making provisions for evaluation, involvement in grant writing, tips on showing appreciation to each member of the partnership, and sharing ideas for innovative, successful partnerships that you can do for your school.

In an effort to create real life learning and teaching opportunities for the students enrolled in Instructional Computing classes, we strive to create partnerships with the public schools. So often higher education involves theory with few opportunities to test and observe in a real life situation; developing partnerships helps solve this problem for higher education. Practicing teachers are struggling to keep up with technology, to learn integration strategies, and view new software; developing a partnership offers an excellent method for the teachers to receive assistance in these areas. Everyone involved increases their understanding of using technology as a tool to enhance learning. Discussion of innovative projects such as "Study Buddies," computer clubs, teacher inservices, maintenance interns, classroom computer project helpers, and technology classes for teachers, will help others creatively explore their own needs, realize that they have much to offer, and develop partnerships of their own. The most common response to a university/school partnership has been, "It is a gift from God!"

Paper
Active Learning in Technical Courses

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Key Words: **active learning, teaming, cooperative learning**

Abstract

The University of Alabama is one of seven schools participating in the Foundation Coalition, an NSF-sponsored partnership looking at educational reform within the undergraduate engineering curriculum. In addition to active involvement in the Foundation Coalition, the Department has re-structured several of its own undergraduate courses around the lines of cooperative learning and technology-enabled education. This includes the re-design of classrooms as well as a shift in focus from a traditional lecture to more of an "active learning" environment.

Introduction

The University of Alabama is participating in an NSF-sponsored engineering education reform project, the Foundation Coalition. The primary goals of the Foundation Coalition are to re-vitalize undergraduate engineering education through the incorporation of curriculum integration, human-interface development (active and cooperative learning), and technology-enabled education. This paper looks at the issue of human-interface development, specifically the use of teams and the teaming processes utilized in the classroom.

The use of techniques such as teaming and cooperative learning have been recognized by a number of researchers as beneficial to the classroom environment [1,2]. These techniques are fairly well-known today, and will not be re-stated in this paper. Instead, the reader is referred [3,4,5] for information on the benefits of teaming and cooperative learning.

Teaming within the Computer Science Department

While teaming is being used in a variety of courses within the discipline, this paper will focus on one specific course within the department. Briefly, the other courses that integrate teaming are senior-level courses in areas such as operating systems, database, and software engineering. While teaming plays an important role in these courses, it is quite common to see teaming in these courses in any curriculum around the country. Thus, potential audience interest in examining one of these courses seemed minimal.

The course in question is a sophomore/junior level course that is designed as part of the "bridge" between the freshman year and the upper-level courses within the major. The freshman year at Alabama is not unlike that found in any number of other institutions, focusing on fundamental programming skills and an introduction to the discipline itself. In addition, our freshman year focuses a significant amount of time during the second semester on basic algorithms and data structures.

The course under examination, CS 325 (Software Development and Systems), is designed to meet two basic objectives of the Department: (1) introduce the students to the concepts associated with object-oriented programming using Ada95 and C++; and (2) transition the students from a PC environment to the Unix workstation environment.

In the past, the main complaint regarding this course has been the fact that it is one of the more "intense" courses within the major. The amount of material within it is significant, and it has often been viewed as a "race to see if we can cover everything this semester" by the instructor. However, we were also receiving signals from the senior-level courses that some of the (what we believed to be) more fundamental issues associated with the course were not being mastered by the students. This fact, coupled with the Foundation Coalition's emphasis on teaming and active learning within the classroom, seemed to provide an ideal testbed for integrating this new approach to the instruction of CS 325.

The remainder of this paper will focus on the use of teams in CS 325 (Software Development and Systems). During the initial semester of "active learning," the basic philosophy utilized was to spend the first half of the course going over the basics/fundamentals of a given topic(s). At this point the lecture would stop and they would get into teams (of three or four) and work on some exercises developed around the "mini-lecture." The course was taught in this fashion during the Fall 1994 semester. This was not true "active leaning" in its purest sense, but rather a combination of lecture and guided recitation. Nevertheless, results were positive, and it was decided to pursue active learning further the next Fall.

During the Fall of 1995, the CS 325 course is being taught in a true "active learning" environment. The class is divided into teams of four individuals, and is located in a room that the Department renovated over the summer to promote the concept of student teams. Instead of individual desks, the students now sit at tables (holding two people each). A team of four will sit at two adjacent tables, and simply turn to face each other during team exercises.

The course utilizes a combination of "lecturettes" and group exercises. Paying attention to the fact that the average adult attention span is approximately 18 minutes, the course proceeds with 15-minute lecturettes and then guided discussions or exercises by each of the groups. The example below demonstrates a class session in which students are introduced to packages in Ada95.

- Five minutes: Introduction/motivation: Review the concept of an ADT. Discuss how conventional programming languages permit operations that might violate the integrity of an abstract data type.
- Five minutes: Using a STACK, have the teams identify five different things a user might do to destroy the stack that cannot be prevented in conventional languages.
- Ten minutes: Identify the basic operations that you want users to perform with respect to STACKS (guided discussion with the class)
- Ten minutes: Have each team identify the basic operations they should consider for the following data types: QUEUE, LINKED_LIST, TREE, DIRECTED GRAPH
- Ten minutes: Overview the syntax used for operations in an Ada package specification
- Ten minutes: Have each team generate a partial Ada package specification for the data types they had identified operations for previously (QUEUE, LINKED_LIST, etc.)
- Ten minutes: Discuss the implementation of the actual data type for STACKS; overview both a static and dynamic approach to the STACK
- Ten minutes: Have the teams construct static and dynamic representations for the data stored in each of their data structures
- Five minutes: Review and summarize the day (package concept, operations visible to user, representation of internal data); What's ahead for next time: package body (implementation)

A few basic observations should now be made regarding the specific organization and structure of the teams in CS 325:

- First, the teams are selected by the students themselves. Each team lasts for approximately four weeks. However, when it comes time to pick a new team, they can not select any of the team members that they had been on a team with before. This way, initially they all know the other members on their team, and as they get more familiar with the class they became more comfortable moving to new teams.
- Second, each team is given a specific task (or, more commonly, a set of tasks) to discuss and complete each day (the same set of tasks is assigned to all teams). Students get credit for each day in which they participate, as a sheet is turned in at the end of the day containing the work done by the team during the class session that identifies the team members present. It is important for the team to have specific deliverables at the end of each day, otherwise student participation is reduced during the class exercises.

- Third, a "reading list" is handed out about every 3–4 weeks (roughly the same time frame as changing teams). On this list are specific topics for specific days, along with what material this corresponds to in the book. This way students have a reminder regarding the specifics they are suppose to be covering in the book on a regular basis. Since approximately half the time in class is spent in teams, it is not possible to cover all the material one would normally cover in the class (all the details of a concept). The students soon pick up on this, and utilize the reading list so that they will be prepared for the daily class activities.
- Fourth, the instructor must make a strong effort to keep moving between teams as much as possible during the teaming. The basic strategy is to go over to a team, listen for about 15–30 seconds, interrupt with a question or two (sometimes directed at a specific person, sometimes to the whole team), and if they are on track then move on to the next group.
- Fifth, time management is much more important than it is in a traditional course. Since the time is broken down into such small increments, it is vital that the instructor keep close track of his/her "lecturettes." The ability to talk at great length on any subject is common among faculty, and keeping focused on a given topic and covering it within the time specified can be quite a challenge.
- Finally, it is important to design the activities such that even the best of teams cannot complete them within the time allocated. The instructor should stress that the teams are not expected to complete the task, but rather to work on it for the duration of the allotted time. Idle teams can be very disruptive (as other teams realize they are working when others are not), and so these "sponge activities" serve a very useful role in the teaming process.

Class performance in these exercises has been outstanding (to date). It should be noted that this class meets for 75 minutes twice a week (8 a.m.–9:15 a.m. Tuesday/Thursday). Most 8 a.m. classes that have been taught by the authors are a real struggle. This class is actually in their seats and ready to work every day. The change in student attitude is remarkable.

Lessons Learned

The authors are firm believers in the potential benefits of utilizing teaming in their courses. However, they have also identified several key issues that cannot be ignored when you incorporate teaming into a classroom environment. These issues are discussed below.

- It is vital that each team have some identifiable "deliverable" that is due at the end of the session. If the students do not have a specific deliverable, it is impossible to keep the team focused on the task at hand. It does not have to be a final, polished product, but the teams must turn in something to indicate the progress they made during the session.
- It is also important for the teams to realize you are interested in their efforts. This normally means that the instructor spends most of the time walking around the room and listening into the team's conversations. Feel free to interrupt and ask the teams questions. Watch a team for a few seconds, ask some (pretty obvious) questions and (occasionally) some more difficult ones to make sure they knew what they were doing.
- Only distribute one copy of the task per team. Handing out multiple copies often led to four people dividing up the work and each doing 25%, instead of working as a team on the entire set of problems. It is a good idea of have extra copies available for all students as they leave the class, but only let the team have one copy while they are working.

Looking over the changes that a faculty member faces during their first semester in a true "active learning" environment, the following two facts seem to emerge as the most fundamental concepts it is necessary to grasp in order to operate in this new environment.

First, it is *extremely* hard for the instructor to yield control of the learning process, and let the students take responsibility for their own education. In an environment such as this, the amount of lecture time is drastically reduced from traditional classes. As a result, it is impossible for the instructor to cover the material to the depth that which he/she is accustomed. Instead, the instructor must focus on the fundamentals, provide accurate and timely reading assignments for the students, and rely on peer pressure (by the other members of the team) to help ensure that each student keeps up with the material. It is very easy to get caught in the trap of "I've got to tell them this, otherwise where will they ever learn it?" However, if you give the students the opportunity, they will often surprise you with their own initiative and abilities. If you expect students to develop an interest in (and ability to perform) life-long learning, you must provide them with this opportunity during their formal educational process.

Second, parallels between the format of a given class session and the 4-quadrant Learning Cycle [5] should be emphasized. The four phases of the traditional learning cycle: (1) motivate; (2) instruct: (3) develop competency; and (4) apply the principle in question. Any of the classes utilizing active learning should also incorporate these basic concepts. For example, when introducing the students to dynamic memory allocation in Ada95, the class session was broken into four major components (with both "lecturettes" and team exercises found in each of the four segments):

- Ten minutes: Motivation of the material (teams identified why dynamic allocation of memory was sometimes needed).
- Twenty-five minutes: Instruction on the concepts. 15 minutes on allocation of memory (with team exercises). 10 minutes on the built-in Ada routines for memory deallocation.
- Twenty minutes: Applications to ensure competency on the part of the students. Students traced through a number of Ada examples (identifying the output produced) developed sample algorithms for a few simple dynamic memory allocation problems.
- Twenty minutes: Students applied the concepts of dynamic memory allocation to the development of a linked list in Ada, complete with procedures to Add, Delete, Print, and Initialize.

This procedure works very well for most (if not all) of the material presented in CS 325. In addition to providing a sense of "closure" for each lecture, the students were able to recall the basic concepts associated with each day, as it usually focused on a single "theme."

Summary

We believe that the implementation of active learning techniques into CS 325 has provided tremendous benefits to the course. The use of teams permits students within the course to not only begin to learn how to interactive effectively with other students (people), but also begins to place the responsibility for learning on the shoulders of the student, instead of the faculty member.

Future plans call for the movement of some fundamental teaming applications into the freshman year of the major. Studies will also be conducted to attempt to identify any changes in the retention rate of majors during the first two years of the curriculum. Student retention rates are at their lowest in the first two years of the major, and it is hoped that the adoption of more active-learning based techniques will help to increase overall student retention.

References

Johnson, D., Johnson, R., Smith, K., "Cooperative learning: An active learning strategy for the college classroom," *Baylor Educator*, Winter 1990, Volume 15, Number 2, pp. 11–16.

Katzenback, J.R. and Smith, D.K., *The wisdom of teams: Creating the high performance of organizations*, Harper Business Publishers, Inc., New York

Smith, K., "The craft of teaching cooperative learning: An active learning strategy," *Proceedings of the 1989 Frontiers in Education Conference*, pp. 188–192.

Bellamy, L., Evans, D.L., Linder, D.E., McNeill, B.W., Raupp, G., "Teams in engineering education," final report for NSF Grant SE-9156176, Arizona State University, Tempe, AZ.

Felder, R.M. and Silverman, L.K., "Learning and teaching styles in engineering education," *Engineering Education*, Volume 78, Number 7, April 1988, pp. 674–681.

Focus

Developing Internet-Based Projects

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Key Words: **Internet, curriculum, interdisciplinary learning, collaborative learning, project strategies, project development**

Exciting projects taking students on adventures all around the world are happening through Internet in the classroom. Examples of these projects will be presented. Teachers can develop their own projects using a model which will be discussed and demonstrated. This model will consider, information literacy skills, interdisciplinary learning activities, areas of problem solving, integration of Internet into the curriculum and designing goals, tasks, and specific outcomes of an Internet based project.

This session will also touch on: identifying potential collaborators for Internet-based projects; developing strategies for project management and timelines for Internet based projects; developing strategies for contacting potential funding resources and participants in your project; developing strategies for creating dissemination activities to share the results of your project; getting media attention for your Internet project.

Panel
Electronic Primary Source Materials in the Classroom

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Key Words: **primary sources, multimedia, teacher education, Internet issues, distance learning, telecommunications, product development**

The Library of Congress National Digital Library Program, in collaboration with the Education Development Center's Center for Children and Technology, is investigating the ways in which the Library's digitized historical collections (WWW and CD-ROM) can be used as a resource for teaching and learning in K–12 classrooms. The National Digital Library collections represent a rich archive of primary source documents from the Library of Congress that can potentially be used by students at all levels to support the development of historical thinking and narrative understanding.

With some exceptions, the content of digital archives can be appropriate across a wide spectrum of ages. But the form that the materials take, and the activity frameworks through which materials are presented, must take account of where children are cognitively, socially and emotionally, and where they are capable of going. In selecting appropriate collections to develop for K–12 students, and especially in developing the teaching materials and activities which will accompany them, this project will investigate the ways in which the Library's digitized historical materials fit with curriculum at the various grade levels, which materials children of different ages will find most appealing and comprehensible, and most important, how to design activity frameworks appropriate to children's different developmental levels.

In this panel presentation, we will discuss the design and development issues associated with creating comprehensible and rich digital primary source materials for K–12 education. Project staff from the Library of Congress will discuss the Library's vision and plan for digitizing its vast resources. Project staff from the Center for Children and Technology will discuss their evolving design ideas and will report on the results of an extensive field test of digital primary source material and accompanying lesson plans being conducted in four schools in the greater New York metropolitan region.

Focus

Basic Desktop Design—Are Your Documents Attractive and Readable?

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Key Words: **desktop publishing, design, page layout**

Now that you've learned to create documents on the computer, will anyone read them? Review the eight basic rules of desktop design and learn how to make effective choices for fonts, justification, headlines and more. Forget the rules our typing teachers taught us and learn to make your documents look professional and readable.

This session is designed for anyone doing newsletters, flyers, brochures, worksheets and handouts with little or no training in design concepts. Many computer users get put in situations of having to do desktop publishing simply because they understand how to use a computer, not because they understand what makes a page look attractive, interesting, and easy to read.

Topics That Will be Covered Will Include:

Eight Basic Design Rules

- Use of a grid.
- Reading patterns & eye movement.
- Balance
- Proportion
- Repetition
- Dominance
- Simplicity
- White Space

Using Fonts Effectively

- Serif versus Sans Serif
- Bitmapped, PostScript, and TrueType fonts
- Text justifications, column readability
- Leading
- Using italics and bolding
- Spacing between sentences
- The en dash and the em dash

Choosing and Using Graphic Elements Effectively

- Breaking up text areas using rules, lines, and pull-quotes
- Illustrations

Informative handouts will be provided with lists of suggested books, periodicals and training materials on the topic of design. This session is not software or computer platform specific.

Focus

Journey North: An Internet-Based Study of Wildlife Migration and Seasonal Change

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Key Words: **wildlife migration, Internet, satellite tracking, phenology, seasons, K–12 science**

Hands-on workshop featuring demonstration of Journey North, an Internet-based program that engages students in the study of wildlife migration and the coming of spring. Using the Internet, students travel "live" with migrating sea turtles, whales, eagles, monarch butterflies, caribou and other species. Migrations are tracked via satellite and by student observations, and reported online to the classrooms via e-mail and/or the WWW. Program also studies phenology events such as ice-out and leaf-out dates, and encourages students to use inquiry-based learning to explore/unlock the secrets of why animal migrations and other spring changes occur. Scientists share their experiences and data as they study the different species with the students, and they also participate in an "Ask the Expert" feature, where students submit questions which are answered by the scientists online.

Workshop highlights classroom activities from Journey North Teacher's Manual which integrate backyard science and Internet technology. A 150-page Teacher's Manual is available, along with a Journey North poster.

Journey North is in its third season, and is funded by The Annenberg Foundation/Corporation for Public Broadcasting's Elementary and High School Project for Mathematics and Science.

Panel

Delaware's K–12 Classroom Network: Every Classroom, Every Child

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Key Words: **telecommunications, education reform, statewide efforts**

Two years ago Delaware was funding educational technology at the level of $0.24 per pupil. Last year that jumped to more than $100 per student as Delaware began the most aggressive state-of-the-art educational telecommunications initiative in the country. What happened, and what are they building? Since 1993, the Governor and State Board of Education have engaged the state in a comprehensive educational reform initiative which includes:

- High academic standards for all students;
- Efforts to ensure all children start school ready to learn;
- Modern technology and textbooks;
- Empowering parents through site-based decisionmaking, school choice, and charter schools; and safe, disciplined schools.

In order to provide an equitable information technology infrastructure for all schools, Governor Carper presented recommendations in March of 1995 which included the creation of a new government agency, the Delaware Center for Educational Technology, and the wiring of every classroom in the state with coax cable and copper and fiber strands for voice, data, video, and future needs. The system specifications were designed to serve the schools well for 15 to 20 years. In June 1995, the Delaware General Assembly approved the Center and the first phase of a three-year funding plan. Phase two funding is in the Governor's budget proposal for FY '97, and the first round of schools are to be wired this summer (1996).

Purpose of the Network

This very large investment of public dollars gained support as legislators, educators and members of the public understood the role of such a telecommunications system in supporting and facilitating education reform. The purpose of this network is to help empower children through the use of information technology to achieve high standards in education. Elements to be addressed include:

- **Instruction:** Through access to exemplary standards-based instructional units, the myriad resources on the Internet and World Wide Web, online collaborations, and a variety of educational technologies;
- **Administration:** By making readily available educational research and literature on those practices and policies which best promote student achievement, and the mechanisms for the collection and analysis of data concerning students and schools, as well as to improve management efficiencies;
- **Professional development:** Via the network, teachers with common professional interests will be able to collaborate, share effective practices, review and discuss video footage of excellent teachers, and access educational research and literature; a database of exemplary curricular materials linked to the new content standards and performance assessments is being developed by the Delaware Education Research and Development Center. Delaware will be working with Educational Testing Services, Inc. and the Online Internet Institute on piloting the online mentoring and support of teachers seeking National Board Certification;
- **Parent/community involvement:** The network will deliver information for parents regarding effective ways to support their child's learning, ways to get involved in their local schools, and the background information for participation in policy decisions concerning education at the state, local, and school levels.

Delaware is in many ways a microcosm of the United States with urban, suburban and rural communities, diverse student and family populations, and a workforce struggling to make the transition from the factory floor to the control panel.

Funding

State funding for the wiring has come from windfall monies which were put into a state infrastructure fund. While planners had not initially considered the schools as beneficiaries of this fund, the Governor and Legislature recognized the role of the state in bringing all schools to an equitable level of telecommunications infrastructure.

Progress to Date (June 1996):

Planning

- During the '94–'95 school year, teams from every district in the state participated in development of district technology plans and a state plan which would support local needs and priorities.

Infrastructure

- T1 lines have been run to every school library.
- 28.8 bps lines with PPP have been established for free dial-in from home for all school personnel living within the state.
- All district offices and all high schools are to be fully wired with copper, fiber, and coax by the end of the current calendar year.

Training

- 40% of the state's Goals 2000 Implementation funding distributed to districts for FY '96 was earmarked for technology training.
- The state provided training and new equipment for 98 school librarians and a cadre of 183 teachers and administrators so that they could help guide the development and selection of network resources.
- The State Board of Education is considering the inclusion of a telecommunications/electronic research component to the proposed teacher recertification requirements.
- Teams of three students and one faculty member from nearly every secondary school in the state participated in Web site development training and are creating sites for their schools.

Resource Development

- The Delaware Center for Educational Technology and the Department of Public Instruction have created a Web site which contains the types of resources described in "Purpose of the Network." This site will be continually enhanced and developed in response to the needs of the students, educators, and parents.
- The Education Research and Development Center has begun work on a "Consumer's Curriculum Information System" which will provide electronic access to exemplary learning units and curricular materials;
- Training was provided to educationally-related organizations (PTA, Business/Industry/Education Alliance, Science Alliance, School Boards Association, etc.) on Web page development so that their resources and support services could be made known via the Web site.

Project

Developing a Networking Course and Lab for Non-Computer Science Undergraduates

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Key Words: **networks, data communications, networking lab, non-computer science, computer science**

Background Information

In today's information age, knowing how to use data communications is extremely important in the business environment. As a result, many non-computer science majors (especially MIS and IS) need to know more about data communications and networks. However, schools versed in traditional computer science curriculums usually require a core set of courses in programming, languages, operating systems/architecture, and data structures before they offer an upper elective in networking. Typically, the networking course focuses on the behind-the-scenes operations such as examining the efficiencies and operations of different data or routing protocols, the construction/operation of application program interfaces, etc. Usually, the networking environment is UNIX using TCP/IP.

Non-computer science students typically present four problems:

1. Often they are not interested in the core courses offered by computer science.
2. Even if they desire to take the core courses, they do not have enough free electives to take all of the prerequisites for a networking course.
3. They are interested in the construction and operation of networks from a user's standpoint. They do not plan on building API interfaces, driver routines, constructing new sockets, etc., but they need to know what is available, how to integrate it into a usable network, and how to manage it.
4. They need a diverse background and hands-on experience in environments other than just Unix (e.g. *Windows NT* and *Novell*).

This project reviews how a small computer science department, offering traditional computer science courses, constructed a hands-on networking course and lab for non-computer science majors on a limited budget.

Presentation Topics

- Overview of the problem (includes above background info)
- Acquiring hardware and software for the lab

    - Examination of issues and alternatives on how our department acquires hardware/software in a limited budget scenario (especially software that is not freeware)
- Building the curriculum for the networking course
    - Examination of curriculum topics for an applied networking environment
    - Discussion of networking course prerequisites
    - Review of student projects and labs
    - Examine the influence of the available resources for the course curriculum
- Operational budget concerns
    - Review issues on keeping the lab operational and upgrade costs for hardware and software
    - Managing and supervising the lab
- Setting realistic goals for the course and the lab
- Faculty training (or retooling)
    - Review of training options which are available to faculty to learn about applied networking

Project
Teaching Programming Through Patterning

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Key Words: **computer programming, patterns, introductory computer science**

Pattern-based programming instruction can provide a non-content focus for instruction allowing for (we think): better instruction, better programming skills, and ultimately better conceptual understanding of programming.

Pedagogy for introductory programming instruction continues to be a common topic in computer science education. Many of us are displeased with focusing on the syntax and semantics of programming languages rather than fundamental concepts of computer science. Additionally, at the end of the course, too many students lack conceptual understanding and still appear unable to supply programming solutions to simple problems. The net result is that students may go through an entire course without ever producing a good program.

We are developing curriculum materials to support a pattern-based model of programming. Learning can be viewed as the brain storing patterns associated with particular experience and later performance can be viewed as requiring a pattern-match between the present situation and previously encountered ones. Thus, as programming problems are encountered, they will be mentally categorized and have solutions associated with them. Similar problems encountered in the future should cause the retrieval of the previously used solution as a starting place for solving the new problem. Our approach is to try to enhance student perception of patterns in the problems and to strengthen the tendency to reuse past work.

Our instruction is based on the general patterns of problems that we have identified rather than on the features of a language. Instruction is focused on problems and solutions rather than syntax and semantics. Instead of being asked to develop their own solutions to new problems, students are provided with (or encouraged to use) solutions to similar problems. The supplied solutions are expected to be "good" ones as they come from the instructor or from slight revisions to programs from the instructor. As students repeatedly encounter problems that reuse those patterns, we believe, their brains encode the patterns and that students will use them as the basis for programs on newly encountered problems, even when solution templates are not externally provided.

The patterns used in the current version of our instruction are shown below:

Figure 1. The Patterns.

```
Process-One-Item, e.g.,
get data to be processed
process the data
output the results
Process-All-Items
prepare for processing
loop over:
get next item
process one item
prepare for next item
perform closing action
Guarded-Action
if guard-condition is satisfied
take action
Alternative-Actions
select appropriate action from the following
condition 1, take action 1
. . .
condition n, take action n
Process-Items-Until-Done
prepare for processing
loop over:
```

```
get next item
if appropriate
take action
prepare for next item
if needed
process last or found item
```

Society

Leadership for Diversity in Educational Technology (ISTE)

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Key Words: **leadership, diversity, equity, technology, ISTE**

Leadership for Diversity in Educational Technology

This session will explore strategies to promote diversity in the leadership and membership of International Society for Technology in Education (ISTE) and the profession and to address the critical information needs of a diverse educational community. An expected outcome of this session is the development of a resource database of people, projects, and initiatives that address the interests, needs and concerns of minority populations.

Project
How Will We Know When We Get There?

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Key Words: **district planning, plan evaluation, goals**

Once a district goes through the process of developing a technology plan, there is a great temptation to let the document gather dust or migrate to a file cabinet. One of the main purposes of developing a plan in the first place was to give the district direction in planning curriculum and determining purchases as it strives to integrate technology into the curriculum. A key component of any technology plan should be an evaluation instrument to determine if the district has met its goals. A sample of evaluation instruments which have been collected, revised and authored by the presenter will be available for examination, revision and discussion. Perhaps collectively a better model can be developed which can be customized for your district.

Components to be discussed will include the establishment of a time line for district implementation of the technology plan, the effectiveness of the training provided to the staff, the adequacy of the hardware and appropriate utilization of the software. If an evaluation indicates that the plans goals have not been met, then what provisions must be made to make the technology implementation successful? Change the plan or adjust the implementation process? The presentation will also address factors which might affect the implementation of a technology plan, and how a district can adjust its plan with changing technological trends?

Paper
Polyhedral Sculpture: The Path from Computational Artifact to Real-World Mathematical Object

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Key Words: **HyperGami, polyhedral models, solid geometry**

Abstract

Mathematics educators often despair at the subject's austere, "abstract" reputation. This paper describes recent work in developing an application named *HyperGami*, whose purpose is to integrate both the abstract and "real-world" aspects of mathematics by

allowing children to design and construct polyhedral models and sculptures. We describe a sample *HyperGami* sculpture, and present our observations during the past year of pilot studies with elementary and middle school students.

1. Introduction: Making Mathematical Objects "Real"

In the popular mind, mathematics has a reputation of being removed from concerns of the real world. Words such as "abstract," or worse—"cold," "remote," "austere"—are often used to describe the discipline. While indeed much of mathematical research does have an undeniably abstract nature, the subject also has its more tangible "real-world" side, as realized in the applied disciplines of engineering, architecture, and design. In this paper, we describe a computational system named *HyperGami* whose purpose is to integrate these twin "abstract" and "real-world" aspects of the mathematical enterprise. In particular, *HyperGami* provides students with an activity that weaves formal reasoning (as employed in computation) into the creation of real mathematical objects: complex three-dimensional polyhedral sculptures constructed in paper.

Before proceeding further into technical discussion of *HyperGami*, it is worth illustrating its style through an example of the type of work one can create with the software. Figure 1 shows a set of paper *HyperGami* penguins made from "custom" polyhedra (as described later in this essay). The various parts of these penguins—the heads, bodies, feet, and bowtie—are variants of particular "classical" shapes (the dodecahedron, cuboctahedron, pentagonal prism, and tetrahedron). Moreover, all the individual elements of these sculptures have been decorated using (a relatively simple subset of) the tools provided by the software.

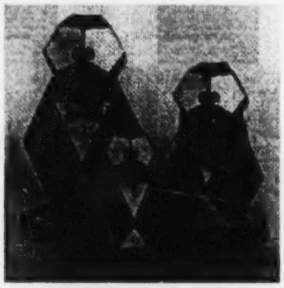

Figure 1. A family of three HyperGami polyhedral penguins.

The purpose of displaying this example is to suggest how computational media may be deployed to extend the venerable mathematical tradition of polyhedral modeling. Certainly, mathematical educators have long used paper models as tangible—and attractive—representatives of the ideas of solid geometry. (Indeed, a set of cardboard models from the 18th century may still be seen on display at the University of Göttingen [Mühlhausen 93].) But such models are often decorated—if at all—painstakingly, by hand; while kits and books for constructing polyhedral models are generally limited to the "standard," or classical, shapes. By using the *HyperGami* system, the student can design not only standard polyhedra but also customized variants of those shapes, and she can decorate those shapes in an endless variety of ways. These novel shapes may then be combined into larger composite forms such as the penguins in Figure 1. The overall effect is to extend the usual practice of polyhedral modeling into a far richer sort of activity, approaching a "mathematical art form."

The remainder of this paper is devoted to a description of the *HyperGami* software, with a particular focus on its use in the creation of polyhedral paper sculptures such as those shown in Figure 1 (we have dubbed these objects "orihedra," suggesting a blend of origami and polyhedral modeling). The following section provides a very brief overview of the software and its major features; the third section presents a scenario showing how *HyperGami* may be used to create a sample paper sculpture. Finally, the fourth section summarizes our observations of elementary and middle school children who have used the software in the past year to create paper sculptures of their own; and we outline related work, as well as our current research directions.

2. HyperGami: A System for Creating Polyhedral Models

HyperGami is written by the authors in the MacScheme dialect of Lisp [S1], and runs on all color Macintosh computers with at least 12M of memory. The system is structured as a "programmable design environment" [Eisenberg and Fischer 94] in that it includes direct manipulation interface features supported by a full-fledged programming environment (in this case, an "application-enriched" version of the basic MacScheme language system).

A view of the *HyperGami* screen is shown in Figure 2. Briefly, the main activity of the program is the design, decoration, and construction of novel polyhedral models. The user may start with standard polyhedral shapes (such as the five regular, or "Platonic," solids), and can then alter those shapes by a variety of means, including both menu-driven commands and Scheme procedures (written in the extended Scheme dialect provided with the system). Once a new shape has been designed, the user may ask the system to "unfold" that shape automatically to produce a two-dimensional folding net pattern; this pattern may be decorated, printed out, and folded up into a new paper object. Figure 2 shows a particularly simple example: here, the user is decorating a folding net for a regular dodecahedron.

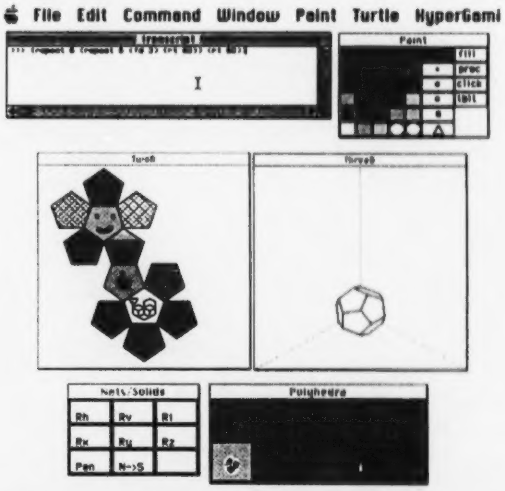

Figure 2. The HyperGami screen in the course of a sample project: the user is creating a decorated dodecahedron. The various windows are described in the text (additional optional windows are not shown here). In the figure, the user has evaluated a turtle-graphics expression, and the turtle (positioned in one of the pentagons toward the bottom) is in the course of drawing a rotated-polygon pattern.

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The heart of the program is represented in Figure 2 by the two large windows labeled **TwoD** and **ThreeD**: these windows display, respectively, a two-dimensional ("unfolded") and three-dimensional ("solid") version of the shape under construction. The **Polyhedra** window provides a palette of starting shapes from which to begin one's design; the **Nets/Solids** window provides various controls for viewing the three-dimensional forms under construction; and the **Paint** window provides, among other things, a selection of standard graphics tools for (e.g.) changing the color or pen width in the process of decorating a folding net. Finally, the **transcript** window is the interface to the application's Scheme interpreter.

Figure 2 depicts a scenario in which a user is creating a decorated model of a dodecahedron. Here, the user has begun the design process by selecting the dodecahedron icon from the **Polyhedra** palette; the system displays a folding net for the solid and a three-dimensional view of the solid in the **TwoD** and **ThreeD** windows, respectively. The user now decorates the folding net using a range of techniques (as shown in Figure 2): regions may be filled with solid colors or patterns, decorated via "customized fill procedures," and painted "by hand" (using the mouse), among other possibilities. In the figure, the user is shown in the course of employing still another technique—turtle graphics—for decorating one of the regions of the dodecahedron's folding net: here, one of the pentagons in the folding net is decorated with a rotated-polygon figure [Abelson and diSessa 80].

This description of *HyperGami* has been unavoidably brief; important features for "linking" the two- and three-dimensional views of solids, as well as many linguistic features of the system's Scheme interpreter, have had to be ignored. (For more detail, see [Eisenberg and Nishioka 96].) In the following section, we will in any event go beyond the current example, in which a standard dodecahedron was constructed, and show how new customized forms may be created.

3. Designing a Polyhedral Sculpture with HyperGami

Creating original paper sculptures with *HyperGami* typically entails the design and construction of novel polyhedral forms derived from simpler shapes. In this section, we illustrate the types of *HyperGami* operations that can be used to create new solids in the context of a sample project—namely, constructing the penguins shown in Figure 1. Note that this section will focus only on the mathematical techniques needed to create new ingredients for sculptures—and not the design skills needed to conceive of those sculptures. We will touch on the latter issue toward the end of this essay.

3.1 The Penguin's Body: "Stretching" a Solid

In creating the penguin's body, we begin with the cuboctahedron—a semiregular solid (i.e., one whose faces are composed of more than one type of regular polygon—in this case, six squares and eight equilateral triangles). The cuboctahedron can be selected through *HyperGami*'s **Polyhedra** palette; it is also accessible through a larger optional palette of the so-called "Archimedean" solids.

Figure 3 shows the idea of how we would like to proceed in making the body of the penguin: at the left, we have the standard cuboctahedron, while at center we have a new variant of that solid, created by "stretching" the original shape along its vertical axis.

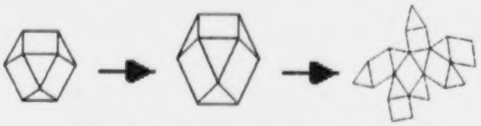

Figure 3. "Stretching" a cuboctahedron into a taller shape, which is then unfolded.

To perform this operation in *HyperGami*, we first select the cuboctahedron; then we select a menu choice that allows us to apply several types of linear maps (rotations and scales) to our already-chosen solid. In this particular instance we stretch the cuboctahedron by 1.4 along the z-axis. Once this choice is made, the system now creates a "stretched" version of the cuboctahedron, and computes a two-dimensional folding net for the solid, as shown in Figure 3. It should be noted that the "unfolding" problem—the task of calculating a folding net from a three-dimensional polyhedron—is quite complex.[Croft *et al.* 91] *HyperGami*'s unfolding algorithm is based on a strategy of heuristic search, and does not always succeed in producing a folding net for arbitrary solids; but it has yet to fail on a convex solid and has succeeded in generating patterns for a large number of nonconvex shapes as well (see [Eisenberg and Nishioka 96] for further discussion).

Once the new folding net for the "stretched" cuboctahedron has been generated as in Figure 3, it may be decorated in *HyperGami* to produce a suitable penguin body. (For the Figure 1 sculptures, two of the triangles were decorated in white—to suggest the penguin's chest and belly—and the rest were decorated in black.)

3.2 The Penguin's Head: "Capping" the Face of a Solid

The head of the penguin in Figure 1 is a variant of the dodecahedron, created by "capping" one face of that solid. The idea is suggested by Figure 4: we take the original dodecahedron and make a new solid by adding a single vertex *v* outside one of the faces of that dodecahedron, drawing new edges to *v*. The result is a solid that looks rather like a head with a beak.

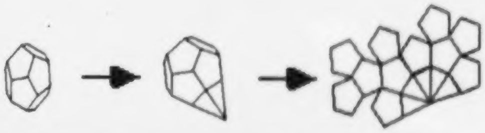

Figure 4. A dodecahedron (left) is "capped" to form a new shape which is then "unfolded" (at right).

In this case, the technique for generating a capped solid would be performed using *HyperGami*'s Scheme language operations: a function named `add-cap-vertex` is used to generate a new solid from an older one. Here is the expression used to generate the shape at the center of Figure 4:

```
(add-cap-vertex *current-solid-object* (read-a-current-
  solid-face) 0.7)
```

The `add-cap-vertex` function takes three arguments. The first argument is a solid (in this case, our "current solid"—the dodecahedron—which has the default name `*current-solid-object*` indicating that it was the last solid object selected); the second argument is a specific face of that solid (here, the `read-a-current-solid-face` procedure allows us to select that face with the mouse); and a "cap height" indicating how far the new vertex should be from the center of the capped face. When this expression is evaluated in *HyperGami*'s language interpreter, the system prompts us to select a face of the dodecahedron, and returns the solid shown at center in Figure 4. This new form may now be unfolded; and the folding net may be decorated to suggest a penguin's head. (In the case of the Figure 1 sculptures, the beak was done in orange, the face pentagons in white—with hand-drawn eyes—and the rest of the head in black.)

3.3 The Penguin's Feet: Creating Custom Prisms

The feet of the penguins in Figure 1 are designed by creating customized prisms. *HyperGami* allows the user to generate a prism based upon an arbitrary polygon—whether that polygon is hand-drawn, created by specifying a sequence of points through a dialog box, or created by language operations. The pentagon used for the penguin's feet was in fact created by a Scheme expression:

```
(define penguin-foot-polygon
(make-closed-polygon
(make-point -0.5 0)(make-point 0.5 0) (make-point 1.1 1.86)
(make-point 0 2.5) (make-point -1.1 1.86)))
```

This polygon was "turned into" a prism by the following expression:

```
(make-general-prism-solid-object penguin-foot-polygon 0.5)
```

The `make-general-prism-solid-object` function takes two arguments: a base polygon, and a prism height. The resulting solid was unfolded and (for Figure 1) decorated in orange.

3.4 The Penguin's Bow Tie

The bow tie of the large penguin in Figure 1 is simply composed of two tetrahedra; the tetrahedron is in fact one of the five regular solids and may be selected (along with its folding net) directly from *HyperGami*'s **Polyhedra** palette. The tie of the Figure 1 sculpture was decorated in red.

Overall, then, the penguin sculptures in Figure 1 represent several important techniques for generating new solids in *HyperGami*: applying linear maps (such as "stretching" maps) to solids, "capping" faces, and creating solids (such as prisms) from hand-drawn or language-specified polygons. *HyperGami* includes still other techniques for generating solids not employed in this example: techniques for "vertex truncation" (essentially, "slicing away" a portion of a solid near a vertex [Holden 71]), for joining together two solid at a face, for creating solids from data structures (lists of vertices, edges, and faces), and for applying certain types of nonlinear maps to solids. The result is a rich "algebra of polyhedra" through which an endless range of new forms may be explored.

4. Experiences with Students; Related Work; Current, and Future Research Directions

4.1 Experiences with Students

During the past year, we initiated our first pilot tests of the *HyperGami* software with a total of eleven volunteer elementary and middle school children ranging in age from 8 to 13. The students worked with us as individuals or in pairs, coming to weekly or biweekly sessions that lasted one to three hours. Not all these children's projects involved creating paper sculptures with *HyperGami*; some projects focused on origami figures (the software may also be used for this purpose [Eisenberg and Nishioka 94]). All of the children did choose, at some point, to create polyhedral figures (though not all of these were full-fledged "sculptures" representing nonmathematical objects like the penguins in Figure 1).

Those several children who did create their own "orihedra" employed sophisticated elements in doing so. One 11-year-old girl used antiprisms and a truncated icosahedron to create a paper hippopotamus; a 10-year-old boy experimented with an elongated icosahedron to create an "alien head"; and a 13-year-old boy expressed his fondness for dinosaurs by building a polyhedral sculpture of a brontosaurus that made use of antiprisms and a "stretched dodecahedron."

In some cases, children have begun with our basic solids and used the software to create their own custom decorations. While working with our "pre-stored" polyhedra, the children can concentrate on learning to use the decorative features of the system without the added complexity of manipulating the solid. This serves as a gentle introduction to the software in which the child arrives at a satisfying finished product. For example, during her earliest interactions with the system, an 8-year-old currently working with us has made penguins (of which she is considerably proud) by filling the outlines of our penguin nets with her own designs.

In designing their own custom polyhedra, students have the opportunity to rethink, and personalize, solid geometry. One student who had worked with the software began by describing "basic shapes ... like cubes" and then continued, "I think everything builds off of these shapes. They are sort of like the primary colors, you know, you mix to get different colors from the three primary colors and you get different shapes with the solid shapes ...." Another student, pursuing a biological analogy, stated that "there are many, totally many kinds of polyhedra out there, but they all start from a simple shape, which is basically their 'genes' ...."

4.2 Related, Current, and Future Work

HyperGami reflects the influence of a number of other efforts, both in mathematics education and in educational computing. Its subject matter is shared with a variety of materials designed for polyhedral modeling, including excellent books by Holden [71] and Wenninger [71] and kits such as the marvelous *Zometool* [BioCrystal]; but, as noted earlier, these materials include no computational component, and they focus on polyhedral modeling for the "classical" shapes (rather than customized shapes) and for strictly "mathematical" purposes. More directly, the elementary-school software package *Shape Up!*[S2] also includes folding nets (though only for a very small selection of preselected solids); and Suzuki [87], as far as we know, was the first practitioner of using polyhedral elements to create larger structures (though his elements were largely undecorated). On the philosophical side, *HyperGami* shares with such software efforts as LEGO/Logo [Resnick 93] both an interest in integrating computational and "real-world" artifacts, as well as an interest in embedding programming languages within applications.

These themes of integration, as mentioned in the previous sentence, are currently motivating our ideas about further research work. At present, we are creating a "children's mathematics book"—an alphabet book of polyhedral sculptures showing the type of work that can be pursued with the system. This book is also intended to explore an issue raised earlier in this essay—namely, the question of how composite sculptures may be conceived and designed (as opposed to the more "nuts-and-bolts" question, addressed in section 3, of how individual parts may be constructed). The alphabet book may thus be interpreted as a catalog of design techniques—what shapes may be used to represent "heads," what shapes act as good "limbs," and so forth.

In the near term, we are working to devise assessment measures to determine what sorts of cognitive progress (or problems) children experience in working with *HyperGami*, particularly in the area of mathematical visualization; many of the ideas of this research are derived from the earlier important work of Piaget and Inhelder [48]. Broadly speaking—and for the longer term—we would like to pursue an agenda of combining computational media with a range of handicrafts (including, perhaps, ceramics, waxwork, puppetry, and so forth); our hope in doing so is that computation, and mathematics, can be viewed as a little less "austere" and a bit more as disciplines that inform both the work of hand and mind.

Acknowledgments

Our gratitude to Hal Abelson, Barry Dworkin, Eugene Hoffman, Mike Mills, and Jim Spohrer for support, inspiration, and great conversations. Zach Nies and Jay Smith did marvelous work extending *HyperGami*. Thanks to Gerhard Fischer and the Center for LifeLong Learning and Design at the University of Colorado, who have provided a home for this research. This work has been supported in part by the National Science Foundation under grants RED-9253425 and a Young Investigator award IRI-9258684. The second author is supported by a fellowship from the National Physical Science Consortium. Work described in the final section is supported in part by the National Science Foundation and the Advanced Research Projects Agency under Cooperative Agreement No. CDA-940860. Finally, we would like to thank Apple Computer, Inc. for donating the machines with which this research was conducted.

Software

[S1] *MacScheme*. Lightship Software. Available through Academic Distributing, Dewey AZ.

[S2] *Shape Up!* Sunburst Communications, Inc. Pleasantville, NY.

References

Abelson, H. and diSessa, A. (1980) *Turtle Geometry*. Cambridge, MA: MIT Press.

BioCrystal, Inc. *Zometool*. Boulder, CO.

Croft, H.; Falconer, K.; and Guy, R. (1991). *Unsolved Problems in Geometry*. New York: Springer-Verlag.

Eisenberg, M. and Fischer, G. (1994). Programmable Design Environments. In *SIGCHI '94 Proceedings*, pp. 431–437. Boston, MA.

Eisenberg, M. and Nishioka, A. (1996). Creating Polyhedral Models by Computer. To appear in *Journal of Computers in Mathematics and Science Teaching*.

Eisenberg, M. and Nishioka, A. (1994). HyperGami: A Computational System for Creating Decorated Paper Constructions. To appear in *Proceedings of Second International Meeting of Origami Science and Scientific Origami*. Otsu, Shiga, Japan.

Holden, A. (1971). *Shapes, Space, and Symmetry*. New York: Dover.

Mühlhausen, E. (1993). "Riemann Surface—Crocheted in Four Colors." *Mathematical Intelligencer*, 15:3, pp. 49–53.

Piaget, J. and Inhelder, B. (1948). *The Child's Conception of Space*. New York: W. W. Norton & Company.

Resnick, M. (1993) Behavior Construction Kits. *Communications of the ACM*, 36:7, pp. 64–71.

Suzuki, E. (1987). *Omoshiro ku kan e no sho tai. (Unique Creativity Utilizing Polyhedra.)* In Japanese. Tokyo: Teruko Nakagawa.

Wenninger, M. (1971). *Polyhedron Models.* New York: Cambridge University Press.

Panel
Meeting User's Needs: The AskERIC Experience

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Key Words: **Internet, K-12, telecommunications, high-performance computing, AskERIC**

The AskERIC Service for Educators, a US Department of Education program, provides education information over the Internet. AskERIC began in November 1992 with a Question-Answering Service conducted over e-mail. Education-related questions sent to AskERIC Central at Syracuse University are read by professional staff and distributed to experts in the ERIC system and the US Department of Education. Personalized responses consisting of Internet, ERIC and other resources are sent to the users within two working days. This human contact provides a comfort zone for naive users who may be intimidated by the network technology. AskERIC currently responds to approximately 600 questions per week.

The question-answering service is a natural vehicle for user feedback. From their questions, AskERIC staff saw a need for an archive of education-related resources that teachers, administrators, school library media specialists and parents could access from their home computers. The AskERIC gopher site was announced in February 1993. The AskERIC Virtual Library is now an extensive gopher and world wide web site of education resources, including hundreds of lesson plans, education listserv archives, and AskERIC InfoGuides (topical guides to Internet, ERIC, and library resources).

AskERIC-sponsored listservs serve as vehicles for the development of communities in cyberspace. It is not unusual for there to be only one librarian per school building, or even district-wide. LM_NET connects 4000 school library media specialists from around the world, giving them the opportunity to share ideas, problems, and solutions on a daily basis—a resource that was not available to them in the pre-networked environment.

AskERIC not only develops resources and services in response to user needs, but anticipates their needs through AskERIC Research and Development, which keeps AskERIC on the cutting edge of network and multimedia developments. Highlighted will be research and development and information technologies associated with the Living Textbook project. These technologies include digital video, text search for video retrieval, and networking. AskERIC partners include Northeast Parallel Architectures Center, SUN Microsystems, and Personal Librarian Software.

Focus
Taking a "Byte" Out of New Technology

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Key Words: **multimedia, classroom, projects, HyperStudio, EasyBook, Kid Pix, ClarisWorks**

This focus session will include demonstrations of multimedia programs as well as other applications of the latest in technology using classroom computers or a computer lab. Programs used include *HyperStudio*, *Kid Pix Companion*, *ClarisWorks*, and *EasyBook*. This session will offer ways for the teacher and computer coordinator to combine efforts and include technology as an effective tool that can enhance the current curriculum. Suggestions will also be offered for teachers using one computer or more in their classrooms. While viewing these child-tested projects and presentations, ideas will be generated that can be taken back to the classroom and applied immediately.

Project
Applying a Model for Training Teachers to Use Technology

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Key Words: **training, use, model, instructional, technology**

The need to train teachers to effectively use instructional technology remains problematic for elementary to post-secondary institutions. Often, schools focus on acquisition of technology or design of a technology curriculum rather than on providing training to ensure that teachers can appropriately use instructional technology. Too frequently, teachers receive computers and other instructional media to place in their classrooms and integrate with the curriculum, with no analysis of their needs as educators and little training and support. Unfortunately, this results in idle technology; or technology used only by the more computer literate students; or in the acquisition of games or other programs that may or may not be appropriate for classroom purposes.

To remedy this situation, we began a training project that resulted in a simple categorization of the educational uses of technology for which a teacher should be trained, a model by which a school can develop this training, and a class designed and taught following the model.

Technology can be viewed as a *tool* to enable teachers to better meet the needs of all students. From this perspective, the uses of educational technology can be placed in three categories: (1) teaching *about* technology; (2) teaching *with* technology; and (3) *integrating* technology. These uses can be described separately but, in practice, may overlap in a variety of ways.

The foundation upon which a school's use of technology, and therefore it's training program, is built is a firm **commitment** by administrators and teachers to pursue these educational uses of technology. A vision of how technology is to be used at the school must be developed along with a corresponding plan of action designed to pursue that vision.

This commitment must include the development of a **support structure**. Three items that *inhibit* the use of technology should be considered when designing a support structure: convenience, assistance and training. Technology should be conveniently located so that it is easily accessible when and where needed by the teacher. When problems arise, the teacher should have someone to call who willingly provides the needed assistance. Finally, there is a need for training on not only the use of technology, but also on how to effectively teach about technology, teach with technology, and integrate technology into the classroom.

This training must begin by creating an **awareness** on the part of the teacher of the various instructional technologies and their educational uses. A teacher cannot realistically be expected to effectively use and integrate a tool of which that teacher is not aware, or is aware of in name only. Creating this awareness can occur in many ways, such as through workshops, in-service or pre-service training, demonstrations, journal articles, electronic bulletin boards, or simply in conversations with other teachers.

Once aware, the teacher needs to learn and **use** technology. While learning and using technology, the teacher should evaluate technology. Considered should be factors concerned with effectively teaching students about technology, teaching with technology and integrating technology into the curriculum. The teacher should evaluate technology not only from a teacher's perspective, but also a student's perspective. At this point, if appropriate, the teacher can **integrate** technology.

The model used in this project to teach teachers to use technology includes the components of commitment, support, awareness, use and integration. It is cyclical indicating the need for schools to regularly evaluate and appropriately revise the commitment and support structure, and for teachers to assess the effectiveness of their uses of technology, making changes if necessary. The cycle also serves as a reminder that the process of creating an awareness, using and evaluating technology, and integrating technology is an ongoing process.

The class developed and taught as part of this project followed this model. Incorporated into the class were elements specifically designed to create an awareness of many different instructional technologies, provide the confidence and skill to use and critique instructional technology, and create the ability to identify where technology might be appropriately integrated into the classroom.

Observations indicate that schools and teacher education programs desiring to better prepare teachers to use technology need to design their training programs to incorporate the components of commitment, support, awareness, use and integration. Teachers must have the opportunity to work through stages of the model and experience the uses of technology before they will begin to make it an integral part of their curriculum.

The discussion of this project will include overviews of the categorization of the educational uses of technology for which a teacher should be trained and of the training model by which a school can develop this training, and then focus on the course developed providing a description of the course and its elements, and a discussion on its success and evolution.

Focus

Making the Most of Multimedia: Planning for Integration, Quality & Assessment

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Key Words: **elementary, multimedia, Kid Pix, HyperStudio, assessment, quality, integration**

Too often, classroom computing projects focus heavily on the hardware and software students use rather than on the learning outcomes. As a result, instructional technology has come to be viewed as an appendage to what takes place in classrooms.

In this presentation, we will discuss ways in which multimedia authoring software can be used to support current thinking about the way children learn and to address the spectrum of intelligences which exist in a classroom of learners. A variety of elementary student-created projects will be shown where technology tools have provided the means by which students have investigated, created, and communicated ideas in powerful ways.

Handouts will include student planning templates and examples of tools for assessing student work. We will also share teaching strategies which help to develop students' metacognitive awareness of their learning and consequently raise the quality of their work.

Project
Train-the-Trainer Internet Project

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Key Words: **training, Internet, library, curriculum development, train-the-trainer**

Internet training have become extremely popular. However, there are few programs to train trainers in giving Internet instruction. A working group from the San Francisco area designed and implemented an Internet "Train the Trainers" program for multi-type libraries. This document details the process used to plan and implement the program, and gives tips on making trainings effective for professionals and end users.

Features

In order to be sure that the courses would contribute a unique niche in this training, the group determine that the following features would be paramount:

- Training with and for multi-type library settings: the courses would encourage cross-training for public, school, academic, and special librarians; ideally, the trainers would represent at least two types of libraries and would generate trainers that would provide outreach to multitype libraries;
- Incorporation of training techniques within the courses: not only would content skills be presented but training tips would be presented in the sessions;
- Hands-on practice so learners can try out their new skills;
- Certification: those participants who attend all sessions would be "licensed" to teach others about Internet features.

Structure

As the group designed the course offerings, several factors came into play:

Course structure was a series of high-day modules offered so attendees could concentrate on one set of skills and would have time to practice them between sessions.

Delivery method was "live" and hands-on to promote peer support and interactivity. The group also knew that most trainees would use a direct training model back "home," so should see a successful modeling of that method. Handouts were also crucial so participants would be reference sheets and training templates.

Faculty had well known teachers, who reviewed the group's content and delivery methods, and taught the sessions. The group identified potential faculty, and asked them the following data: training and library experience, Internet areas of expertise, availability of time and travel, honorarium fees, and list of references. Clear syllabi, a single instructor, and a group member liaison for the entire series was the best situation.

Sites had to be geographically accessible; parking and public transportation availability were considerations. The room needed to have at least ten workstations linking to the Internet, training equipment, and refreshments. College campuses were the usual option.

Scheduling was complex. Faculty and site had to be available at the same time; all sessions were to be scheduled at the beginning so participants could register for the whole series, and write one check to cover costs; the group gave a discount to those willing to sign up on that basis. It was better to offer an entire series in one area and then offer it in the opposite side of the region.

Cost was fairly easy to determine. The group checked the cost of similar courses, determined overhead (mainly administrative costs), and looked for a break-even situation. $50 seemed reasonable; interestingly, the cost also had to be high enough so attendees would think it was a top-quality program.

Content

First, the group had to decide what librarians needed to know in order to use the Internet effectively. The present series consists of the following sessions: Training techniques (to lay the groundwork for training focus), Communicating on the 'Net, Getting wired, Accessing remote information, Navigating the 'Net, and Getting graphic on the 'Net. Next, group members investigated course descriptions and syllabi to determine specific concepts. The question of detail arose as the group wanted to standardize the modules so several different faculty members would be sure to cover the same material.

Administration

Recruitment was tedious. Finding good faculty and good facilities, even trainees, proved to be an effort. Some of the avenues for publicizing the courses included: Internet, announcements to library systems and professional organizations, personal phone calls, conference presentations, and articles.

Registration methods changed over time. At first, a lengthy registration form was developed in order to give faculty an idea of the entering skills of the trainees. An easy solution was found to take care of disparity and time constraints: all registration was done by e-mail.

Liaison efforts were crucial for the training to be successful. Group members acted as liaisons to faculty, to sites, and to series. Typically, one person contacted the faculty person and kept in regular contact throughout the trainings. Another person contacted the site and made sure that the trainer had everything needed to conduct the class. The session liaison acted as a go-fer and assistant each time, and insured continuity between sessions.

A web page accomplished many tasks simultaneously. It became the main communication channel, describing the regional library council and committee. It listed faculty and facilities, provided the course syllabi and schedules, and included certificated participants. In the future, individual library systems and organizations can assume the administrative tasks as they choose which faculty and sites best meet their needs. They can also post their courses on the Web page; most likely, specialized sessions will be the focus (i.e., children's services, medical sources, information "packaging"). The URL is http://www.calacademy.org/library.

Project
Linking "Yesterday and Today" to Social Studies (Elementary K–5)

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Key Words: **telecommunications, expository/content area writing, social studies, multimedia, multiple intelligences, thematic, literature, making real-life connections**

As educators we have been guided by the major goals of social studies curriculum for more effective and meaningful approaches to instruction. Our projects, Wellesley Yesterday and Windows to Boston '96 specifically focus on the following:

- Making history real so that students appreciate the significance of the past on the present
- Connecting social studies to other curriculum areas
- Developing a community awareness through meaningful real-life experiences
- Using technology as a tool for classroom learning and instruction
- Linking relevant, accurate background experience and "new" conceptual knowledge
- Developing an awareness of the individual as an important valued person and contributor to our society
- Appreciating and respecting individual and group differences
- Children need to develop a meaningful relationship with the past

The best way for them to gain an historical perspective is to provide concrete experiences that link past to present. For our project Wellesley Yesterday, we contacted a Wellesley historian, Beth Hinchliffe, former speech writer for President George Bush. She helped choose seven historical sites which were visited and investigated by teams of students. Guest historians were interviewed and discussed specific information that related to each site's history.

This unique learning opportunity also integrated computer technology. Using appropriate software, the students created a multimedia database, CD, slideshow, videotape, and calendar. The Theory of Multiple Intelligences, as described by Howard

Gardner, was also addressed, since the children were involved with activities to develop their seven intelligences.

In the Project Windows to Boston '96, a Boston Tour Guide for students written by students was developed. Students once again made on site visits to unique Boston sites and utilized various pieces of technology to create Windows to Boston '96, the guide.

Windows to Boston '96 helped students to integrate different areas of the curriculum in a meaningful manner, i.e., students designed both individual and group educational stacks using the program *HyperStudio* with specific facts and information as a result of their investigation (on site) visits and library research. This project also gave young children opportunities to read/write expository material and has become a primary resource not only for students but also for grade three teachers who teach the Boston Dalston core curriculum. Windows to Boston '96 also introduced telecommunications to this multi grade 2/3 classroom by enabling them to compare/contrast Boston to the Dalton School (part of Columbia University's Teacher College) through online activities. The unveiling of Windows to Boston '96 was a tremendous success!

Project
The Internet, PCs, and Electronic Communities: Student-Centered Learning in Computer Science

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Key Words: **computer science, hypermedia, student-centered, Internet, programming, World Wide Web**

This session will discuss the Program Design and Programming (PDP) project which focuses on developing and implementing a student-centered virtual classroom. PDP incorporates courseware and tools that create a student-centered learning environment supporting the goal of educating a computing professional, rather than training a programmer. Learning and curricula are the essence of the project.

The virtual classroom centers on an integrated set of software tools: 1) a hypermedia notebook (the PDP "text book") with class syllabus, class notes, executable examples, laboratory exercises, and programming assignments, 2) a pedagogic CASE tool (Design Tool) with code generation facilities and information flow checking, 3) an algorithm animator, 4) a programming language facility integrating editor, compiler, and debugger, and 5) a news group to support electronic mentoring by peers and faculty. This virtual classroom resides primarily on the UTPA computer science web site which contains the HTML version of the hypertext, laboratory and programming assignments, and facilities for electronic retrieval and submission of work.

The goal of our introductory computer science course is to provide a foundation for the continued study of computer science, mathematics, engineering, and the sciences. As such, the focus is on acquiring lifelong learning skills: providing learning and analysis skills, rather than training a computer programmer. Nonetheless, the course requires that students begin acquiring concrete skills to implement programs along with developing the broader theoretical foundation for continued study. Tools mastery is challenging in and of itself, but the application of the more abstract skills is even more challenging. Often the students' focus becomes the tools and not the application of the underlying theory. Developing and applying these problem solving skills requires time and training, as well as creativity and a willingness to take risks. Students must have time to practice and gain confidence in their skills as they develop an understanding of computing ideas, and the amount of time varies from one student to another. Unfortunately, the typical classroom setting provides little flexibility to address varying rates of skill acquisition.

The courseware and tools used in the PDP project have been developed to allow us to incorporate elements of electronic technology to enhance both the learning and the teaching environment. The PDP hypertext, Design Tool, and the algorithm animator allow us to present ideas visually and interactively in an environment which facilitates experimentation. Students use the hypertext as a scaffolding to organize concepts and explore the knowledge base, while completing practical work using tools that are relevant to the real world. Students have an opportunity to express themselves via multiple paths—program design, programming, and writing [text]—and to enhance their problem solving skills. The virtual classroom allows students to learn in individualized styles, at their own rates, and at convenient times and locations, independent of classrooms and campus.

Focus

Using Curriculum-Based HyperCard Stacks To Facilitate Classroom Computer Interaction

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Key Words: **HyperCard, classroom, curriculum, templates, stacks, scanning, inservice**

This focus session will demonstrate how classroom teachers can transfer traditional paper and pencil tasks to a computer medium via *HyperCard* and thus facilitate independent computer use for all students in their classrooms. Readymade templates for immediate student use will be demonstrated as well as an introduction to adapting readymade Hyperstack templates to current teaching units. The session will present simple techniques for scanning black and white pictures directly from curricular materials and pasting them into *HyperCard* templates. Participants will also be presented with a proven successful plan for engaging whole classrooms with the capabilities of the Macintosh computer. Teachers who have a working knowledge of *HyperCard* as well as novice computer users will learn how students can become independent computer users while learning the versatility of the Macintosh. Participants will discover how special needs' students included in the classroom can successfully participate in computer activities. Teachers will be amazed at how this approach motivates students to generate ideas for written expression tasks and how perfectly it lends itself to the "publishing" step of the writing process.

This presentation will leave participants with a beginning understanding of how *HyperCard* templates can assist them in incorporating computers more effectively into their present teaching units and introduce them to an approach that can provide positive, productive computer experiences for all students in their classrooms.

Panel
The District Network—"We Have Built It and They Are Here"

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Key Words: Internet, networking, communications, staff development

Lincoln Public Schools is a large midwestern school district, comprised of 60 buildings, 2,500 teachers and over 30,000 students. An eight million dollar connectivity plan is well underway that provides both telephones and direct network connections to every classroom in the district. How do we begin to implement a large network successfully, and change the way we communicate and do business? What are the implications for staff and student use?

This panel will discuss all components of creating a successful district-wide network and providing access to the Internet and other network services. Topics will include funding (both local and state), developing and implementing the connectivity plan, the infrastructure (hardware and software choices), staff development and training, community partnerships, and student usage issues.

- **Funding**—Learn how state legislation and an implementation plan for Nebraska helped the whole state, how local district funds were allocated, and how successful grants came into play for this connectivity plan.
- **Implementation plan**—Panelists will describe the steps necessary for the physical implementation, how long the implementation has taken, and who has been involved.
- **Hardware solutions for the network**—Discussion will include brief descriptions of network components: file servers, remote access servers, hubs, routers, and solutions for integrating older existing equipment and midframe computers.

- **Software solutions for the network**—Learn what software makes it possible to implement a completely graphical Internet interface via network or remote access connection. Client software for PPP, SLIP, e-mail, gopher, file transfer, network news, World Wide Web, and Telnet will be covered. Discussion will also include strategies for supporting home installations.
- **Sharing resources**—Topics will include network servers, scheduling software, printers, and other shared resources.
- **Network (and district) services**—Setting up an anonymous FTP site, WWW server, e-mail server, and other services do provide unlimited resources to the network users. Learn what server software was used to set up each of these services.
- **Staff Development/Training**—Trainers have developed multiple courses and workshops to help guarantee successful experiences with Internet exploration, and have discovered which conditions must exist to make the training work! Some training is district-wide, some is site-based, but all users of the Internet must have a minimum of 15 hours training in order to get their account.
- **Student Usage**—Discussion will include successful student projects, district computer usage agreements, and how to teach responsible use of the network.
- **Community Partnerships**—Panelists will describe successful partnerships with businesses and the community.

Project

Computational Science Projects: A Tool Connecting Math, Science, and Computing

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Key Words: **programming, computational science, mathematical modeling, science education, math education**

Computational Science Description

Because of the computer's inherent characteristic as a mathematical device, one of the most powerful applications of the computer is as a tool used to support a mathematical investigation. As the computer has increased in its computational power it has added new dimensions to the study of mathematics and science. One relatively new dimension, made possible because of the computer's great computing power, is the use of "computational science" techniques in a mathematical or scientific investigation. There are two basic components of a computational science project. The first is the development of a mathematical model of the phenomenon being studied. This model is "programmed" on the computer and then used for experimentation. For example, a mathematical model of the orbit of the planets around the sun could be developed and programmed on the computer. This model could then be used for experimentation as questions related to the model are investigated. Parameters can be modified to see how those changes affected the model. For example, one of the parameters in the model of the planets' orbit might be the speed at which each planet moves around the sun. This parameter could be changed to see how increasing the speed at which a planet travels changes that planet's orbit around the sun.

The second component of a computational science project is "visualization." Experimenting with the computer-based mathematical model often creates large amounts of data which is difficult to interpret on its own. Therefore, the data is often put into visualization software which creates a picture of the data. It is generally much easier to see trends and differences when looking at a picture or graphic rather than the data itself. If we were investigating the effect of a change in gravity's force on the orbit of the earth, for example, the program we developed for this purpose would probably generate a large amount of data (numbers) which represent the earth's movement around the sun over time. If we only looked at the numbers it might be hard to determine what happened to the earth as the gravitational force was altered. If we looked at a picture or graph representing the numbers, however, it might be easy to see that the earth was gradually pulled into the sun and destroyed.

Computational Science and Education

Computational science techniques have the potential for use in teaching students about science, mathematics, and computing, and how these different disciplines are related. As students complete a computational science project they are using the computer to study different mathematical and scientific concepts, and the computer becomes a bridge between math and science. For example, if a group of students were investigating the regrowth of a forest after a fire they might take the following steps as they studied the issue using computational science techniques:

1. They might first develop a mathematical equation which models the growth of a forest over time.
2. They might then write a computer program or develop a spreadsheet using their mathematical model and use that program or spreadsheet to experiment with their model.
3. This experimentation would likely generate data which would be studied visually, and would lead to some conclusion being made about the growth of a forest.
4. This may lead to changes being made to the model and more experimentation. The students would have been studying a biological situation using mathematics and the computer is the bridge between the two.

Programming a mathematical model is not the only way to generate data. An equation in a spreadsheet can be used to "program" the model, or students could collect the data themselves. For example, students could collect environmental data about different cities in the world off of the Internet (or exchange data with other groups of students at those cities), import that data into graphing or visualization software, and then study the resulting graphs to answer questions such as how a city's altitude affects its yearly rainfall amount.

Adventures in Supercomputing

Programs introducing high school students to computational science are beginning to appear. These programs generally seek to involve students in projects investigating some problem using computational science techniques. One such program is the Adventures in Supercomputing program funded by the Department of Energy. This program provides access to computers at Department of Energy research laboratories to students and teachers as they work on scientific or mathematical problems, often with the aid of a mentor scientist. A major goal of this program is to increase students' interest in science, mathematics, and computing by having them investigate a topic of their choosing using computational science techniques. Schools in this program have dedicated a class (or classes) which incorporate the Adventures in Supercomputing curriculum. This curriculum is centered around teaching computational science techniques and having students complete computational science projects. At the end of the school year each of the five states involved in the program holds a statewide expo where students are given the opportunity to demonstrate a long term project that they have been working on throughout the year.

Computational science techniques are so useful because the computer is taking care of the often time-consuming details of performing the mathematical computations and developing the graphic, freeing the scientist, mathematician, or student to focus their attention on the phenomena under investigation. Besides learning a great deal about the specific topic being studied, the process of completing a project provides students with many opportunities to learn and apply many general mathematical and scientific concepts that are useful in any mathematical/scientific investigation.

Project

Software Development and Hardware Adaptation for Severely Handicapped Individuals

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Key Words: **disability, handicapped, authoring, assistive technology**

The Intermediate District #287 technology support team, **C**omputer **A**ssistance **P**rogram **S**pecialists (CAPS), has twelve years' experience training educators, parents and students in the use of assistive technology for education and transition applications in all special education areas. Their skills include hardware adaptation, equipment set-up and troubleshooting, and adaptation or development of software to meet specific individual educational needs in Early Childhood Education through Post Secondary and transitional programs. Students are severely handicapped in one or more of the following disability areas: Physically Handicapped, Visually Impaired, Hearing Impaired, Developmental and/or Emotional/Behavioral Disorders, and those with Transitional/Vocational needs.

Using a variety of authoring packages, individualized programs have been prepared, addressing areas such as vocabulary expansion, spelling, language and reading skills, daily living skills, and concepts from various other special education and mainstream curricula. A few examples of programs authored specifically for special education include: a simulation of ordering from fast food menus and related math concepts; individualized programs for severely mentally handicapped students to practice their name, address and telephone number; a practice exercise to find the correct department for grocery or variety items; daily living skills programs, including cooking, money, work skills, and safety; and programs which combine graphics, sound, and alternative input devices to allow multi-handicapped low functioning students to control and enjoy computer cartoon slide shows or coloring books as leisure activities.

In some cases, the need is for an original program specifically tailored to functional needs of the disabled. A few examples of this type of program are: an electronic answer sheet which allows physically handicapped students who cannot complete pencil/paper tasks to complete any classroom worksheet by typing their answers into the electronic worksheet on the computer and printing their answers without aide intervention; large font math drill and practice programs for use by students with visual limitations; CAI programs in which screens are read by a voice synthesizer for use by vision impaired students.

Students with physical handicaps that affect their ability to access text materials and communicate through speaking and/or writing often fail to acquire adequate literacy skills. Intermediate District #287 has provided support in the area of assistive technology so that all students with the cognitive ability to learn to read and write, even the most physically limited of them who lack the ability to speak or to access keyboards, have a means of communicating both orally and through written text. This presentation will cover hardware and software applications that have been successfully used in helping students with motor disabilities access the computer, participate in curriculum activities, and develop better literacy skills (reading, writing, and knowledge acquisition). Because most of the schools which serve our students use Apple-based computers the applications presented will have been used on Macintosh computers; however, almost everything that is presented could be accomplished on a DOS or *Windows*-based system as well.

The Accessible Literature Project allows children with significant physical limitations independent access to literature by providing popular children's literature selections which have been scanned into computer authoring shells. The authoring shell consists of *HyperCard* stacks which are designed to hold graphics, text and sound; this allows the physically challenged reader to choose buttons on the screen which will turn pages forward or backward, or request that text be read aloud using the MacinTalk voice. These computerized books have benefited students in educational settings, who are now able to participate in reading groups, and have provided them accessibility to the enjoyment of reading for pleasure.

Students use assistive technology to help them independently and actively participate in classroom learning and work production activities. The most successful implementations of technology are those that allow students to be as efficient as possible in their interaction with their computers. A wide range of alternatives are available that may make technology more accessible to students with motor impairments. An overview of possibilities for both keyboard entry and mouse operation will be discussed including alternate entry systems, keyboard emulating interfaces, adaptations within the computer itself, commercially available standard devices, and software-based adaptations.

While access to the computer may seem to be the most challenging aspect of using assistive technology with students with severe physical disabilities, this is not, in fact, the case. Efficient (relative to the student's physical abilities), independent access has been attained by all of the 130 students in our program for the physically handicapped who use computers. The bigger challenge has been to creatively use software to allow students to produce both written and graphic work, to participate in curricular activities including geography and math, and to develop written language skills. In order for students to effectively use their computers in classroom settings, our program has explored and used a variety of software. While the most frequently used software is commercially available, authored software and software created with scanned text and workbook materials have served the specific needs of a number of students. Applications using a variety of commercial software programs will be shown. In addition, we will demonstrate authored software created on a variety of authoring systems and addressing diverse curriculum requirements.

Among the most important things we have learned, is that competence and independence are key skills that may, in the end, be the essential components of success. All assistive technology systems are works in progress: assistive technology changes, students change, and settings change. We are challenged to provide the means through technology to allow students to attain the highest level of competence and independence possible as they progress along the path to success.

Society

Student Assistants Help Improve Teaching and Learning through Technology (AAHE)

Steven Gilbert

Director, Technology Projects

American Association for Higher Education (AAHE)

Mary Russell

Assistant Professor

Computer Science Department

Providence College

Using students as assistants is one of the few practices that helps close the gap between demand and availability of technology support services in educational institutions—without requiring vast additional investments. This presentation will summarize a variety of efforts to develop local cadres of undergraduate students to work with their peers, with the faculty, and with K–12 teachers and students to use information technology to improve teaching and learning.

Steven Gilbert will describe general issues and a variety of models learned from the work of AAHE's Teaching, Learning, and Technology Roundtable. Mary Russell will explain the Computer Science Internship program at Providence College, in which undergraduate education students work for credit helping to teach K–12 teachers and students how to find, select, and use computers for teaching and learning. Computer science majors in the same program help provide technical support within the local K–12 schools.

The audience will be invited to participate in a discussion of extending these models more widely and to include graduate students and K–12 students as assistants. Finally, we will explore how these efforts can best fit with other programs of school-college collaboration.

Paper

Why Teach Computer Programming? Some Evidence About Generalization and Transfer*

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Key Words: **transfer, generalization, structured programming, higher order thinking skills, Karel**

Abstract

The assertion that "higher order" thinking skills can be improved by learning to program computers is not a new one. The idea endures even though the empirical evidence over the years has been mixed at best. But, there is no reason to expect that all programming courses will have identical, or even similar, effects. Such courses typically differ more by the languages in which they are taught than by anything else, and rarely do they explicitly address higher level instructional goals. To properly assess the extent of transfer, or any other learning, empirical measures must be criterion referenced to specific curriculum objectives.

This paper describes the results from three field experimental studies. In two of them, ninth graders who learned structured programming methods using the Karel the Robot teaching language performed considerably better on a series of expository writing tasks than did students in the studies' control groups. In the third study, students who began their introductory programming methods course with Karel performed substantially better on difficult structured programming tasks using Pascal.

Programming and Transfer

Why should students study computer programming? Aside from the pressing need to educate properly future programmers and software engineers, one often hears the argument that programming generates transferable problem solving and thinking skills. But is programming really the new Latin?[1, 35]

Undoubtedly it is not, if we are looking for evidence of widespread, incidental transfer to all possible areas of higher level cognitive processes[38, 34, 14, 33, 20, 16]. Transfer may be widely touted as a reason for teaching programming, but the assertion is based on mixed results empirically,[1] with the strongest claims often based only on anecdotal

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[1] Actually the positive effects shown in some studies are only of weak magnitude. The size of effects should not be confused with their statistical significance.[21, 37, 22]

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Thanks to David Kaufer for his many insights about the writing process, and the original idea behind this study. Michele Matchett coauthored the CMU Writing Quality Rubric that appears in this paper's Appendix, graded the Minneapolis essays, and participated in many productive discussions about the paper's content.

evidence. Clearly the case for transfer from programming has been overstated. Indeed introductory programming courses often have been characterized by disturbingly high failure and drop rates. We seem to have enough trouble teaching the narrow subject matter[16, 12], never mind transfer of generic thinking skills. Yet the insight still remains compelling to many educators.

Recent empirical work does show more evidence of transfer than some critics have conceded[29, 26]. However a great deal more remains to be learned about the conditions where transfer reasonably can be expected to occur[7, 10, 32, 31].

Programming deals, or at least can deal, in structure and abstraction. Yet it does so in an uncommonly concrete and tangible manner: programs are realized in a physical machine, that students can touch and on which they can see immediate results of their logic.[2] Unfortunately, though, programming languages are only tools, and certainly do not assure that curricula and teachers will focus explicitly on generalizable problem solving skills[11, 36, 19, 19, 4, 14, 33, 16].

Many introductory programming courses limit their attention to writing short, syntactically correct, but contrived programs. Serious attention to topics such as procedural abstraction are often postponed to more "advanced" courses. Explicit consideration of debugging strategies tends to be neglected altogether[4]. There is little if any reason to expect such courses to teach programming very well, much less transfer to other domains[12].

So What Ought We be Teaching Anyway?

Properly done, introductory programming courses can foster at least two important sets of thinking skills: disciplined attention to details; and high level abstraction/planning/organizational/design skills. Though both sets of skills characterize programming proficiency, the former usually gets emphasized by default. Students write short programs graded on the basis of whether they "work," because getting them to work requires considerable attention to error prone syntax and tool invocation details. The latter barely get spoken to, since the programs novice students write tend to be so short and lacking in abstract complexity. Hence we reward tenacity rather than conceptual clarity in design and implementation.

Methodological Confounds

Many transfer studies suffer from an all too common fault: namely actuarial description is not the same as explanation[9, 13]. Indeed, one ought to expect minimal effects when students who have completed many different, widely divergent, programming courses are lumped into the same predictor categories[21]. Rather, we need knowledge about the specifics of curricula to design appropriate criterion referenced indicators of effect.

Moreover it may be impossible to do the definitive experimental study in field conditions. Internal validity is bound to be compromised in the classic trade-off for external validity. Too often we have small Ns, and less than ideal design and

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[2] At least since Socrates, educators have stressed the importance of active involvement by students in the learning process. Similar ideas underlie notions of inquiry, case studies and "constructionist" learning.

experimental subject selection criteria. So confidence in results must come through internal consistency and replication.[3]

The three field experiments reported here were done as spin-offs of a larger project that focused on the development and evaluation of structure editor based programming environments[6, 11, 12]. Most resources in the larger project were devoted to the development of the software, and evaluation of its value in the learning by novice programmers of software engineering skills and knowledge.

The external validity is quite defensible in all three studies. Yet the Ns are small and the control conditions are imperfect. Still, several individual relationships are statistically significant. Moreover the results across the various relationships are quite consistent, which is highly unlikely by chance, especially with small numbers of cases[28].

Transfer or Associative Learning?

Clearly it is difficult to establish conditions that induce extensive incidental learning without explicit instructional intervention. Transfer in that sense is undoubtedly rare. Only the most outstanding students are likely to apply what they have learned in one domain to another in a truly novel manner. But it is more than enough to demonstrate associative learning, where higher level abstractions are explicitly taught and connected across traditionally separate subject matter boundaries. It is difficult enough to establish direct learning effects in educational research. I am more than happy to show evidence of associative learning across the curriculum.

Transfer from Programming to Writing

On the surface, writing is an unlikely candidate for "far transfer" from programming. Yet both fields share a common concern for planning, organization, structure and design. However properly presented programming methods courses can get to the essentials of planning and design much more quickly and easily than can writing courses. Introductory programming language and problem semantics are much simpler than those found in a rich (and vague and ambiguous) spoken language. A common problem for writing teachers is that students must spend a great deal of time learning and summarizing the basic facts of a topic before they are ready for any serious attempts at synthesis and analysis. Early emphasis is by necessity on the concrete before the abstract[15].

Karel the Robot and the Karel GENIE

Richard Pattis' *Karel the Robot* [27] teaching language has extremely simple semantics, allowing it to be taught in a very short period of time, with early and sustained emphasis on the procedural abstraction of complex tasks. The GENIE syntax directed structure editing environment[4] simplifies programming in Karel even further, while also providing a powerful set of online design and testing tools.

The Karel Language

Named for Karel Capek, the Czechoslovakian playwright who wrote *R.U.R.* (Rossum's Universal Robots), Karel indeed is a pleasant and "gentle introduction to the art of programming." Equally important, it is a serious high level language that focuses immediately on the essentials of programming method and problem solving. Even students who initially are reticent about programming find themselves learning a great deal before they realize what has happened.

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[3]. The importance of replication is fundamental to science. Unfortunately the notion remains foreign to too many scientists who crave definitive proof.

[4]. The Karel GENIE is distributed by the Chariot Software Group. For further information or to place an order (catalog # 570-0801), contact them at 800/CHARIOT. A Pascal GENIE is also available through Chariot.

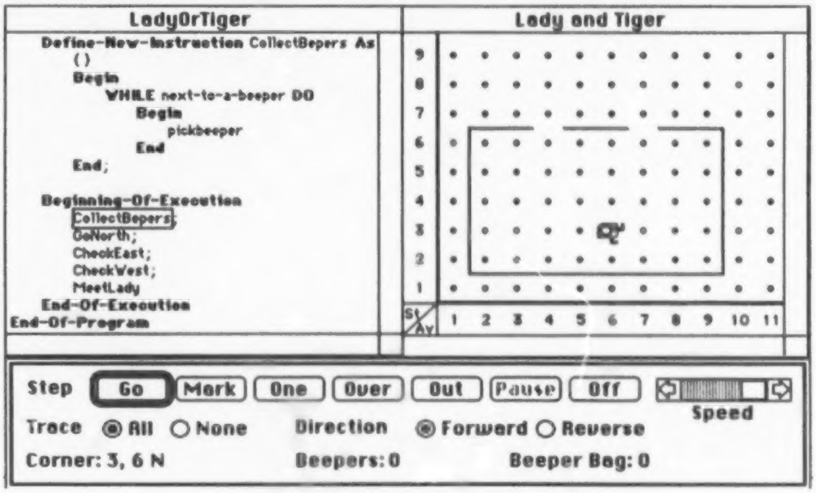
Karel is an imaginary robot who moves through a Cartesian coordinate quarter-plane of "streets" and "avenues." It is easy for students (and teachers) to anthropomorphize problems in Karel's "worlds." But the problems are by no means trivial intellectually.

The language requires very little attention to extraneous detail. It is a sparse language, with only *five* primitives, almost no concrete syntax (none with a structure editor), "no" variables, and *no* subtle input/output details. Karel is easy to learn, even for middle school-aged children. Thus novices can attempt some rather non-trivial problems after a very short period of study.

An excellent introduction to programming methodology, Karel introduces key structured programming concepts, including the major logic control structures of many other "more serious" high level languages. Yet, because of the absence of distracting details, Karel also is actually more amenable than "real" languages to early serious study of control abstraction.

Of particular value in an expository writing context is Karel's emphasis on modular programming and procedural abstraction. This is accomplished through user definition of new instructions, which are functionally equivalent to Pascal parameterless procedures.

The language was designed to enable teachers to emphasize top-down, modular design skills that would be transferable to programming in other algorithmic languages such as Pascal. The anecdotal evidence from those who have taught, and learned, with Karel is that it can perform that role admirably well. Karel's combination of new instructions and simple problem semantics does seem to help students to tackle conceptually complex search and traversal problems in an organized, intellectually manageable manner.



```
    Define-New-Instruction CollectBepers As
        ()
        Begin
            WHILE next-to-a-beeper DO
                Begin
                    pickbeeper
                End
        End;

    Beginning-Of-Execution
        CollectBepers;
        GoNorth;
        CheckEast;
        CheckWest;
        MeetLady
    End-Of-Execution
End-Of-Program
```

Trace ● All ○ None Direction ● Forward ○ Reverse

Corner: 3, 6 N Beepers: 0 Beeper Bag: 0

Figure 1. Karel's Run Time System:
Tracing Karel's Movement Through One of His Worlds

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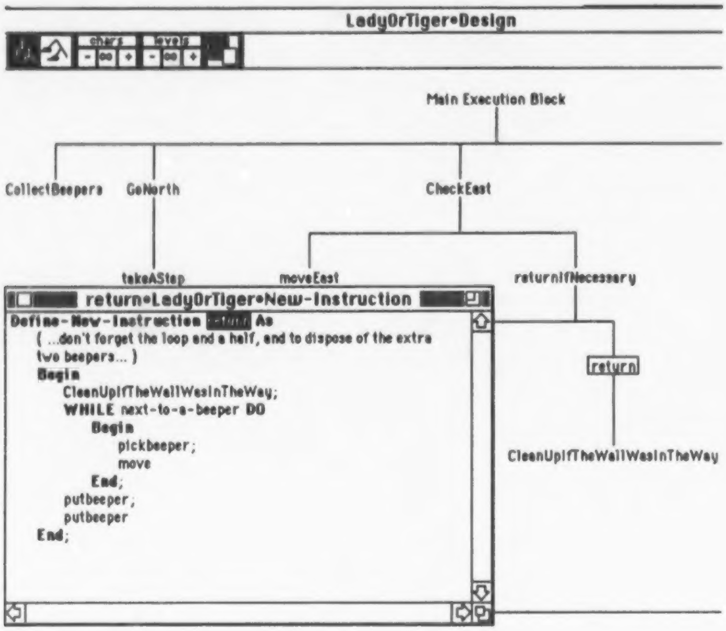

```
Define-New-Instruction return As
   ( ...don't forget the loop and a half, and to dispose of the extra
   two beepers... )
   Begin
      CleanUpIfTheWallWasInTheWay;
      WHILE next-to-a-beeper DO
         Begin
            pickbeeper;
            move
         End;
      putbeeper;
      putbeeper
   End;
```

Figure 2. Karel's Design View & a Scope View

The Programming Environment

As shown in Figure 1, the Karel GENIE is a "seamless" environment that integrates syntax free structure editing with high level "CASE[5] like" design tools and powerful run time testing and debugging tools.[6] The basic structure editing functionality and run time system make it even easier to cover Karel and programming methods comprehensively with young (and not so young) children in a very short time period.

The structure editor based design tools may be even more important[30, 6]. It is possible to display concurrently different aspects of a program in alternative "views" that are *not* limited to the program's concrete syntax. For example the "design" view depicted in Figure 2 allows the programmer to focus attention in a hierarchical, graphical manner on the program's high level procedural call structure. "Scope" views, such as the one also shown in Figure 2 may be used to attend to lower level implementation details. Since program structure is maintained in an underlying structure database, changes made in any one view are reflected elsewhere immediately. In the case of the design view, one can use it to understand the structure of an already existing program, and/or to map program code from the graphical representation.

Results

As already indicated, initial analyses have found statistically (and substantively) significant results, showing transfer from Karel (or at least associative learning) in two separate domains thus far: "far transfer" to expository writing; and "near transfer" to

---

[5]. "CASE" is an acronym for Computer Assisted Software Engineering.

[6]. GENIE also adds recursion and comments to the Karel language.

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programming performance in a standard structured language (Pascal). The results of three separate studies are reported here.

Expository Writing -1

In this study a group of Minneapolis ninth graders learned Karel the Robot in the context of a team taught, interdisciplinary science course. Another group covered a unit on the mechanics of word processing taught by the same teacher during the same time period.[7] Students in both groups completed the same major writing assignment: a research design for a year long project in field biology, chemistry and/or ecology.

The two groups were chosen on the basis of administrative convenience (periods 4 & 5). However we are aware of no known prior selection effects. Students in both classes had similar overall course schedules and extra curricular activities and similar grade point averages.

We emphasized several parallels between good programming and good writing, both in structuring our Karel curriculum unit and assessing writing quality. The writing samples were blind graded, following the grading rubric that is reproduced as an appendix to this paper. Following similar assessment procedures with high inter coder reliability used in Columbus, Ohio, California, and elsewhere[8, 3, 25], the rubric focuses on structure and design criteria. As seen in the appendix, we drew explicit parallels from our own computer science program grading rubrics, informed by the theoretical framework implicit in previous writing assessment rubrics.

The student science project research designs were completed about ten weeks after the Karel unit. Unlike the short essays so prevalent in English classes, these writing samples tend to be longer (up to ten pages) and are based on topics that the students knew well.

All of the students received the same exhortations to structure their essays in a well organized fashion, but the computer science teacher did draw specific analogies with programming methods for the Karel group. Hence any effects can be better characterized as evidence of associative learning as opposed to true incidental transfer.

As seen in Tables 1 through 4, the Karel group did indeed perform considerably better on blind graded writing samples. Interestingly enough, on first reading, the grader (a writing teacher) was struck by the poor grammar and spelling in both groups' essays. However, using the CMU rubric to assess organizational structure, the papers basically fell into two piles.

Table 1. Median Writing Quality Scores*

	Karel	Control
Expressed as:		
Raw Score†	20	16
% of Total Possible	77	56
X Component Score	3.67	2.67
N =	16	16

---

[7] The Karel unit lasted about four weeks, after which the experimental students also were introduced to the word processing topics covered by the control group. The teacher's impression was that the Karel students in fact did equally well on the word processing tasks. They seemed to enjoy the work with Karel, which also introduced them to common Macintosh editing conventions.

* Individual student scores are simple summed composites of all six grading criteria summarized in the appendix.

† p = .05 according to Mann-Whitney U-Test Criteria

Table 2. Categorized Writing Quality Scores*

	Karel	Control
highest (23–24)	44%	31%
high (18–22)	44	6
low (16–17)	12	25
lowest (13–15)	0 100%	38 100%
N =	16	16

* Individual student scores are simple summed composites of all six grading criteria summarized in the appendix.

p = .01 according to Chi^2 Criteria

Table 3. Repetition Rubric Criterion Only*

	Karel	Control
highest (4)	75%	31%
high (3)	19	69
low (2)	6 100%	0 100%
N =	16	16

* p = .01 according to Chi^2 Criteria

Table 4. Hierarchy Rubric Criterion Only*

	Karel	Control
highest (4)	38%	38%
high (3)	56	19
low (2)	6 100%	44 100%
N =	16	16

* p = .02 according to Chi^2 Criteria

Tables 1 and 2 report the summary results using a simple summed index based on all six grading rubric criteria summarized in this paper's appendix. Individual items are notoriously unreliable. But it is worth noting that the Karel group performed better on all six component indicators. Even with the small number of cases in the experiment, the repetition and hierarchy differences reported in Tables 3 and 4 are statistically significant.[8]

Expository Writing -2

Conceived as a pilot study, this experiment was conducted with ninth graders in a Kansas City suburb. In it we were less concerned with experimental design niceties than with demonstrating to ourselves that the idea had merit. We were aware of the fact that Karel has been used in middle school computer science curricula. But we also wanted to satisfy ourselves that it is possible to teach the language in a short time period to less technically oriented students.[9] The results were encouraging in their own right.

Two groups of students were drawn randomly from the same ninth grade language arts class. One group left class early in the semester for a three week unit on Karel taught by the school's lead computer science teacher.[10] The other group did Karel at semester's end. The entire class completed three writing assignments in the interim.

Grading of the three assignments was done by the writing teacher who participated in the study. Although the grading was not done blind, the teacher did pool all of the assignments into one group rather than grading them separately, and reported that he indeed was unaware of the students' group membership while grading. The grading was based on the participating teacher's explicit organizational criteria, which are summarized in a note to Table 5.

Table 5. Pilot Study Writing Performance Median Scores*

	Karel First	Control	p = †
Three Paragraph Work			
Raw Score	97	83	.04
Residual	+9	-5	.44
Three Paragraph Paper			
Raw Score	69	21	.01
Residual	+10	-20	.04
Reading Test			
Raw Score	75	59	.02
Residual	+2	-3	.19
Karel Grade	84	80	.04
N =	13	13	—

* Grades on the three writing assignments were based on the following criteria, and constrained to a zero to 100 point scale by the participating teacher: topic sentence=1; explicit conclusion=1; supporting details=1 each; coherence (transitional device and direct references to other related information=3; one of the above=2; none used, can follow=1; can't be followed=0). The Karel grade

was a summary performance grade assigned by the computer science teacher who taught the Karel unit.

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[8]. Of course the probability that all six would consistently favor the Karel group is highly unlikely by chance alone, especially given the small N. Remember the multiplication rule[28].

[9]. We also have begun work with third graders, who seem quite capable of learning Karel.

[10]. She also taught Karel to the writing teacher.

† According to Chi^2 Criteria

As can be seen in the table, the group who completed the Karel unit first did better on all three writing assignments. But there was a confound: they also did somewhat better on Karel. Perhaps they were better motivated earlier in the academic term and/or the Karel work itself was a good motivator, such that they paid better attention to their subsequent writing tasks. In spite of the random assignment, possibly there was indeed a selection effect with the small number of cases.

Hence I also calculated residual scores, based on the difference between the students' actual scores on each of the three writing assignments and their predicted scores given the positive relationship between performance on Karel and the writing quality measures. In the residuals analysis the Karel first group still did better on all three assignments. Given the small number of cases only one relationship was statistically significant but the characteristic differences were present in all three instances.[11]

Of course one can attribute the results to explicit instruction and resultant associative learning rather than to "true" incidental transfer. As already noted, the writing teacher did become somewhat familiar with Karel during the experimental period. The students also may have realized that their teachers thought programming experience could impact on their writing. But, unlike in the Minneapolis study, explicit parallels between Karel and writing were *not* emphasized in the writing class.

Near Transfer to Programming in Pascal

A major purpose of using Karel in an introductory programming methods course is that it facilitates very early attention to non-trivial issues of procedural (and control) abstraction. Such abstractions presumably make for a simpler transition to Pascal, where students will expect to use modular programming as a matter of course.

In this last study Karel was taught as an introduction to work in Pascal by ninth graders in a Pittsburgh area private school. One group studied Karel for about six weeks in total, with heavy emphasis on procedural abstraction and explicit consideration of relatively complex control abstraction as well. This group thus spent comparably less time on Pascal as a result.

The other group also did some Karel. The participating teacher felt strongly that it was important to use Karel enough to familiarize the students with the GENIE software environmental semantics. However these students were quickly weaned from Karel, having worked with no procedurally complex Karel programs.

The two groups of students were chosen on the basis of administrative convenience from the school's introduction to computing course. However, based both on the teacher's judgment in a small class where he knew the students well and a review of school records, there were no known selection effect differences between the groups.

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[11] Once again note that consistency across relationships is much less likely to occur by chance alone than is a single significant relationship.

Table 6. Near Transfer from Karel to Pascal

	Karel	Control
Game Program		
median	85	85
first quartile	80	56
% failing grade*	0	25
Course Grade		
median	85	83
first quartile	79	56
% failing grade*	0	25
N =	9	12

* $p = .05$ according to Chi^2 Criteria

As shown in Table 6, the Karel group in fact did better on both the "capstone" final program assignment and on final course grades. The programs were graded for both procedural abstraction and functionality.[12] The Karel group's programs were both better structured procedurally, and tended to include more complex functionality and better looking graphical user interfaces.

Again the small number of cases make it unlikely that any one relationship is statistically significant. But the characteristic group differences remain. Moreover there were in fact significantly fewer failures in the Karel group.

Implications for Teaching Writing

Clearly teaching students to be good structured programmers will not obviate the need for teaching writing! As seen in the Minneapolis study, the Karel group's written essays showed room for considerable improvement in attention to spelling and similar "low level" syntax details. Of course such is not surprising; the Karel programming lessons purposefully ignored such issues. But what is impressive is that a short introduction to programming methods apparently did serve to help the same students better organize their essays for structure and readability.

Moreover the transfer seems to be *asymmetrical*.[13] That is, it seems to be easier to teach well structured programming than writing. Since the semantics of both the language and problem (with Karel) domains are simpler than in writing essays, there is far less detailed information to summarize before the students are asked to analyze and synthesize.

Of course we should continue to build (computer based) tools to teach writing skills[23, 23, 17, 2]. After all, computers are well suited for supporting data hiding, revision, hierarchical organizational and related tools. But schools also must do much more to encourage making connections across the curriculum.

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[12]. The assignments were not graded blind. However the teacher did pool them into one group. Since so much time had passed following the Karel unit, he claimed to be unaware of group membership at the time of grading.

[13]. Of course none of the data directly support this assertion about asymmetrical transfer. But it seems both a very plausible conjecture and worthy of further research[5].

Conclusions

In the three studies reported here I have been able to demonstrate some intriguing transfer effects attributable to programming in the Karel the Robot teaching language. Of course such effects require proper attention in the classroom to issues of structure, organization, planning and design. Although this particular language does facilitate such attention, even it does not insure that teachers will focus on programming method and problem solving as opposed to language constructs alone.

All too often programming courses have been notoriously badly done. The response in many secondary schools has been to drop programming altogether, in favor of computer literacy courses organized around spreadsheets, word processors, databases and similar standard software applications. Yet some of us continue to believe that appropriate programming education is (and will become increasingly) essential for both pre-professional and general education[1, 35]. I hope that these results will contribute to a continuing dialogue and effort to improve programming education, with serious attention to the possibilities for computing across the curriculum.

References

[1] Bonar, J., "Everyone Will Be a Programmer," *Technology and Learning*, July 1987.

[2] Britton, B. K., and S. M. Glynn (eds), *Computer Writing Environments: Theory, Research, and Design*, Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1989.

[3] California Association of Teachers of English, "California Essay Scale," in *A Guide for Evaluating Student Composition*, Urbana, Illinois: National Council of Teachers of English, 1965.

[4] Carver, S., "Learning and Transfer of Debugging Skills: Applying Task Analysis to Curriculum Design and Assessment," in R. Mayer (ed), *Teaching and Learning Computer Programming: Multiple Research Perspectives*, Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1988.

[5] Carver, S., and M. Walker, "In Search of General Planning Skills," *Proceedings of NECC '89, National Educational Computing Conference*, Boston, June 1989.

[6] Chandhok, R., D. Garlan, D. Goldenson, P. Miller, and M. Tucker, "Programming Environments based on Structure Editing: The GNOME approach," *Proceedings of the 1985 National Computer Conference*, Chicago, 1985.

[7] Chatel, S., F. Detienne, and I. Borne, "Transfer among Programming Languages: An Assessment of Various Indicators," paper presented at the Fifth Workshop of the Psychology of Programming Interest Group, PPIG5, Paris, December 1992.

[8] Columbus Public Schools, *The Columbus Rubric for Writing*, Columbus, Ohio: Columbus Public Schools, 1987.

[9] Converse, P., "Attitudes and Non-Attitudes: Continuation of a Dialogue," in E. Tufte (ed), *The Quantitative Analysis of Social Problems*, North Reading, Massachusetts: Addison-Wesley, 1970.

[10] Fix, V., and S. Wiedenbeck, "Designing a Tool for Learning Ada Using Empirical Studies," Proceedings of *The Fifth Workshop of the Psychology of Programming Interest Group (PPIG5)*, Paris, December 1992.

[11] Goldenson, D., and B. J. Wang, "Use of Structure Editing Tools by Novice Programmers," in J. Koenemann-Belliveau, T. G. Mohr, and S. P. Robertson (eds), *Empirical Studies of Programmers: Fourth Workshop*, Norwood, NJ: Ablex Publishing Corporation, 1991.

[12] Goldenson, D., "Learning to Program with Structure Editing: An Update and Some Replications," *Proceedings of NECC '90, National Educational Computing Conference*, Nashville, June 1990.

[13] Hovland, C., "Reconciling Conflicting Results Derived from Experimental and Survey Studies of Attitude Change," *The American Psychologist*, 14 (1959).

[14] Johanson, R., "Computers, Cognition, and Curriculum: Retrospect and Prospect," *Journal of Educational Computing Research*, 4 (1988).

[15] Kaufer, D., C. Geisler and C. Neuwirth, *Arguing from Sources: Exploring Issues Through Reading and Writing*, New York: Harcourt-Brace, 1989.

[16] Kurland, D., R. Pea, C. Clement and R. Mawby, "A Study of the Development of Programming Ability and Thinking Skills in High School Students," in E. Soloway and J. Spohrer (eds), *Studying the Novice Programmer*, Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1989.

[17] Kurland, M., and A. Bardige, "Language: The Next Generation of Writing Tools," *Proceedings of NECC '89*, National Educational Computing Conference, Boston, June 1989.

[18] Linn, M., and M. Clancy, "Can Experts' Explanations Help Students Develop Program Design Skills?" *International Journal of Man-Machine Studies*, 37 (1992).

[19] Linn, M., and J. Dahbey, "Cognitive Consequences of Programming Instruction: Instruction, Access, and Ability," *Educational Psychologist*, 20 (1986).

[20] Mayer, R., J. Dyck and W. Vilberg, "Learning to Program and Learning to Think: What's the Connection?," *Communications of the ACM*, 29 (July 1986).

[21] McCoy, L., and N. Dodl, "Computer Programming Experience and Mathematical Problem Solving," *Journal of Research on Computing in Education*, (Fall 1989).

[22] Mohamed, M., *The Effects of Learning LOGO Computer Language Upon the Higher Cognitive Processes and The Analytic/Global Cognitive Styles of Elementary School Students*, unpublished Ph.D. thesis, University of Pittsburgh, 1985.

[23] Neuwirth, C., R. Chandhok, D. Kaufer, P. Erion, J. Morris, and D. Miller, *"Flexible Diff-ing in a Collaborative Writing System," Proceedings of CSCW '92 Sharing Perspectives*, Toronto, November 1992.

[24] Neuwirth, C., D. Kaufer, R. Chandhok, and J. Morris, "Issues in the Design of Computer Support for Co-authoring and Commenting," *Proceedings of CSCW '90 Conference on Collaborative Work*, Los Angeles, October 1990.

[25] Odell, L., "Defining and Assessing Competence in Writing," in C. Cooper (ed), *The Nature and Measurement of Competency in English*, Urbana, Illinois: National Council of Teachers of English, 1981.

[26] Palumbo, D. B., "Programming Language/Problem-Solving Literature: A Review of Relevant Issues," *Review of Educational Research*, 60 (Spring 1990).

[27] Pattis, R., *Karel the Robot: A Gentle Introduction to the Art of Programming*, New York: John Wiley & Sons, 1981.

[28] Payne, J., "Fishing Expedition Probability: The Statistics of *Post Hoc* Hypothesizing," *Polity*, 7(Fall 1974).

[29] Pennington, N., and R. Nicolich, "Transfer of Training Between Programming Subtasks: Is Knowledge Really Use Specific?" in J. Koenemann-Belliveau, T. G. Moher and S. P. Robertson (eds), *Empirical Studies of Programmers: Fourth Workshop*, Norwood, New Jersey: Ablex Publishing Corporation, 1991.

[30] Roberts, J., J. Pane, M. Stehlik and J. Carrasquel, "The Design View: A Design Oriented High Level Visual Programming Environment," *Proceedings of the IEEE 1988 Workshop on Visual Language*, Pittsburgh, October 1988.

[31] Scholtz, J., "Transfer by Experienced Programmers: A Longitudinal Study," *Proceedings of The Fifth Workshop of the Psychology of Programming Interest Group (PPIG5)*, Paris, December 1992.

[32] Scholtz, J., and S. Wiedenbeck, "Learning New Programming Languages: An Analysis of the Process and Problems Encountered," *Behaviour & Information Technology*, 2 (1992).

[33] Seidman, R., "New Directions in Educational Computing Research," in R. Mayer (ed), *Teaching and Learning Computer Programming: Multiple Research Perspectives*, Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1988.

[34] Singley, M. K., and J. R. Anderson, *The Transfer of Cognitive Skill*, Cambridge, Mass.: Harvard University Press, 1989.

[35] Soloway, E., "Why Kids Should Learn to Program," *Proceedings of the 6th Canadian AI Conference, Montreal*, 1986.

[36] Soloway, E., J. Spohrer and D. Littman, "*E UNUM PLURIBUS*: Generating Alternative Designs," in R. Mayer (ed), *Teaching and Learning Computer Programming: Multiple Research Perspectives*, Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1988.

[37] Tu, J., and J. Johnson, "Can Computer Programming Improve Problem-Solving Ability?" *ACM SIGCSE Bulletin*, 22 (June 1990).

[38] Wu, Q., and J. R. Anderson, "Knowledge Transfer among Programming Languages," *Proceedings of The Fifth Workshop of the Psychology of Programming Interest Group (PPIG5)*, Paris, December 1992.

Appendix: The CMU Writing Quality Rubric

Organization and Composition

Hierarchy (top-down design)

4 The central idea is stated very clearly and examples and details are used as support. The subordinate ideas/examples/details are stated separately in clearly connected hierarchical fashion. Good transitional words and phrases as well as sectional headers delineate the sections.

3 While the central idea is stated, subordinate ideas, examples and details are not always well developed to support and develop the main argument of the paper. The use of some transitional devices helps indicate the delineation of sections.

2 The central idea is vague with no development or supporting details/examples. Few, if any, transitional devices are used.

1 There is no central idea. There are also no examples or details and the author seems to have used "spaghetti logic" when writing this paper.

Sectioning (modularity)

4 Ideas/information are logically developed and expressed in a separate cohesive fashion (e.g. sections) instead of being interwoven with other ideas.

3 The ideas/information are presented in a logical manner, but the author may stray from the topic and occasionally interweave ideas or information.

2 The ideas/information are often interwoven which makes it difficult to determine how the author has sectioned the information.

1 There is no indication as to how the author has sectioned the ideas/information.

Distinction Between Detail and Abstraction (granularity)

4 Major ideas are well-emphasized by keeping details and examples distinct (perhaps but not necessarily in separate sections) from those ideas.

3 Although major ideas tend to be emphasized, examples and details are not always kept distinct.

2 The major ideas are often unclear because details and examples are intermingled with those ideas.

1 Details and examples are generally indistinguishable from major ideas.

Repetition (repetitive code)

4 The authors repeat information only when the repetition clarifies their arguments. When doing so, the authors use effective paraphrasing.

3 Although the author repeats information when it is necessary, he/she also occasionally repeats information when it is not necessary. The author does, however, usually use effective paraphrasing.

2 The author tends to be unnecessarily redundant and does not use paraphrasing effectively.

1 The paraphrasing and repetition of ideas/information suggest that little thought was given to the topic.

Information

General Data Definitions (data structure/definitions)

4 General classes/types of information are defined explicitly perhaps in a single location with any structural relationships among those classes stated explicitly.

3 While definitions and/or relationships are explicitly stated, structural relationships are sometimes omitted.

2 While definitions and/or relationships are stated, they are vague and/or incomplete.

1 General classes and structural relationships are rarely if ever defined.

Specific Instance Declarations (data declaration/instantiation)

4 Specific instances of information are explicitly described in the context where they are used or by explicit reference to another context if that information has been used there.

3 Specific instances of information are often defined or referenced and these definitions and references are usually in context.

2 Specific instances of information are sometimes described or referenced but usually not in context.

1 Rarely if ever is explicit information described or referenced.

Grading Score Sheet

____ Top/down design (hierarchy)
____ Modularity (sectioning)
____ Granularity (distinction between detail and abstraction)
____ Repetitive Code (repetition)
____ Data structure/definitions (general data definitions)
____ Data declaration/instantiation (specific instance declaration)
____ Total Score

Panel
Breaking the Barriers: Telecommunications and Teaching in Rural America

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Tennessee Valley Project

Goal: To enable teachers of children in K–8 to enrich their science teaching, to generate enthusiasm for learning science within their students, and to actively involve their students in the learning process.

Funded in 1994 by the Annenberg/CPB Math and Science Project, the Tennessee Valley Project is dedicated to science education reform in grades K–8. Eight Tennessee counties, 30 schools, and 123 teachers and librarians are actively involved. To meet its goal, the project initiated activities along four strands: telecommunications, constructivism, standards, and inquiry-based instructional activities. During the first year of the project, teachers studied and tested methods of the constructivist approach of

Science-Technology-Society (STS) and learned how to incorporate telecomputing into their teaching.

In July 1995, they launched the second year of the project by designing telecurricular, inquiry-based science projects created within the context of STS which considered environmental themes. During the 1995–96 school year, Tennessee Valley Project students tested and compared the quality of water along the Tennessee River and its tributaries; built terrariums and working models of water; examined waste management within their home communities and experimented with recycling; built greenhouses and studied plant life; and examined and compared sources and uses of energy within their homes and communities. They used telecomputing as it is used in real life by working scientists or any group of people addressing common issues, corresponding via e-mail with their contemporaries to share their experiences and compare their findings. Meanwhile, their teachers continued and will continue to enrich their science teaching through the constructivist strategies of STS, the vision of science teaching and learning expressed within the National Science Education Standards, and collaborations with other teachers and reform communities across Tennessee and the nation.

"Reach for the Sky" Project

"Reach for the Sky" is a telecommunications project which has given rural teachers access to the Internet. During the first year of the project, 22 teachers of grades 3–12 with special interest in math and science, received training in the use of the Internet and in the creation and use of telecurricular activities. In the second year, these teachers acted as mentors for an additional 80 teachers from a five state region in the Pacific Northwest who received all training online.

The ability of rural teachers to share work from their classrooms through online experiences has been very positive. These teachers have been instrumental in school districts getting their faculty and students online. "The Reach for the Sky" teachers have also been helpful in assisting community leaders who are interested in establishing community networks.

The goals of "Reach for the Sky":

- Providing teachers access to telecomputing equipment, sustainable connectivity, training, and technical support.
- Linking teachers to the Internet science/mathematics resources and data bases.
- Networking teachers with local, national, and global communities of peers and experts.
- Assisting teachers to create and conduct telecurricular units and to mentor other teachers in the development and implementation of similar units.
- Showcasing teacher innovations in the use of the Internet and telecomputing which provide role models of educational renewal.

Rural teachers can be part of the technological revolution sweeping the world of education. While access to the Internet may be less easy from a rural community, "Reach for the Sky" teachers have embraced the opportunities provided.

The goals of overcoming isolation and of the renewal of math and science teaching are reachable. Telecommunications has the potential to bring about significant changes in the lives of teachers and students. The journey towards realizing that potential can be made in a rural setting.

TOPS (Teacher Online Projects)

Teacher Online Projects is designed to develop online services to support rural classrooms (teachers and students) in the application of problem solving techniques for community-based projects to improve their math and science skills.

Through staff development activities and the use of online networks, ten teams of rural middle school teachers and community members implemented an instructional model to improve student achievement consistent with national standards in math and science. TOPS teams received training and support as they guided their students in identifying a community problem and designing the solution to problem.

Students worked as mathematicians and scientists using the appropriate techniques and skills to solve the problems. Teams communicated with other teams, shared information, contacted math and science education experts, interacted with researchers, and searched for information through a variety of online resources via Internet.

The five objects for Teacher Online Projects are:

1. Students, guided by their math and science teachers, will design a solution to an identified community problem.
2. Students and teachers in the Teacher Online Projects project will access and share information with others through a variety of networks connected through Internet.
3. Math and science teachers from rural communities will belong to a "virtual community" with others working on similar projects to share experiences, teaching strategies, and project results.
4. Students will work toward achieving selected goals of the math and science standards, identified with their teachers as they apply problem solving techniques to solve a community-based problem.
5. Document and disseminate the process for providing access to appropriate resources and teaching strategies for rural math and science teachers.

Focus

Multimedia Tools for the Journey

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Key Words: **multimedia, collaborative learning, curriculum integration, HyperStudio, ClarisWorks, Kid Pix Studio, HyperCard**

"Because learning is an act of exploration, technology can equip the learner with the tools to make the most of the journey."

Teachers have always known that students learn best when they are actively engaged. Aware that multimedia offers many such opportunities, teachers have been bringing an increasing number of multimedia-based educational resources into their classrooms.

Teachers also know that the connection students make on their own are what's really most meaningful and lasting. So, to take further advantage of the strengths of multimedia, many teachers are now providing multimedia development tools for their students—helping them to use the engaging resources for their own knowledge construction.

To provide a framework as students work together to build their own knowledge, collaborative learning adds a structure for the discussion as well as a database that facilitates participation by everyone.

This presentation will provide a demonstration of each of these important issues: multimedia-based educational resources, multimedia development tools and collaborative learning.

Project

Implementing a Comprehensive Instructional Technology Staff Development Plan in a Large School District

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Key Words: **staff development, teacher education, K–6, mentorship, TUG, instructional technology**

Background

Independent School District 196 is located in the Twin Cities area, with an enrollment of 25,000 students. A $78 million bond referendum was passed Spring of 1994 to accommodate district growth; $4.9 million dollars were allocated for technology. During the next two years, a well-developed technology plan was implemented: 1,000 computers were placed in classrooms, 30 local area networks (as well as a wide area network connecting 30 sites) was installed, and major telecommunications improvements were made. These improvements were strongly welcomed by teachers, students, and parents, and enthusiasm for staff development in technology is at an all-time high. The district already had a well-developed and progressive K–5 Integrated Technology Curriculum, and was starting a similar curriculum for secondary. However, with this large infusion of technology into classrooms in a short amount of time, the district was presented with a staff development challenge for 2,000 teachers.

Components

A comprehensive staff development program is working to provide a wide range of instructional technology training opportunities through a variety of forums. The plan includes numerous technology support workshops, a K–5 mentorship program, on-site technology inservices, K–12 instructional technology graduate credit courses, and a technology user group.

Technology Support Workshops

The district has a technology center with both Macintosh and IBM training labs. Many teachers that attend classes have identified technology education as an area for development on their personal growth plans. Classes must be approved by each teacher's principal because classes are held during the school day, and the substitute cost is a building expense. Teachers may also earn continuing education clock hours for attending classes. Some examples of classes include: Introduction to IBM *Windows*, *Microsoft Word* for *Windows*, *Microsoft Excel* for *Windows*, Introduction to the Macintosh, *FileMaker Pro*, Macintosh Troubleshooting, Internet in the Classroom, *HyperStudio*, and *Microsoft Works*.

K–5 Mentorship Program

In order to better meet the needs of integrating technology into the elementary classrooms, a K–5 Mentorship program was developed. Three certified staff from 18 elementary schools were selected to serve as technology mentors in their building. These teachers were provided with a Macintosh PowerBook, training on software, and a stipend. The goal of this "train-the-trainer" mentor program is for all classroom teachers to become comfortable using word processing, database, desktop publishing, graphics, telecommunications, and multimedia applications in their daily instruction. Teachers are expected to master the same assessment criteria that is expected of students.

Onsite Technology Inservices

Beginning in the Fall of 1994, it became apparent that additional training would be needed at each building after the building's local area network was installed. A series of training classes were offered at each building, before and after school. The classes included an overview of the building's local area network, using the electronic mail system, and using *Microsoft Works 4.0*.

K–12 Instructional Technology Academy

In the Summer of 1995, the K–12 Instructional Technology Academy Level I and II district graduate credit courses were offered. The courses were developed to provide in-depth training through a week-long, three credit graduate course. Twelve courses trained over 180 teachers on technology integration in to the classroom. The Level I course introduces classroom teachers to a variety of educational technologies that can be incorporated into daily instruction to enhance student learning. Because instructional technology involves the process of using software as well as equipment, both were covered. Participants learned basic Macintosh system and network operations, as well as an introduction to word processing and database capabilities of *Microsoft Works 4.0*. The Level II course focused on the next level of technology integration into the classroom, highlighting multimedia presentation packages, desktop publishing ideas, grade management software, and specific ways to use the Internet in daily curricular and classroom activities.

Technology User Group (TUG)

In the Fall of 1995, the ISD 196 Technology User Group (TUG) was formed. The user group meets monthly from 4–6 p.m. The purpose of TUG was to provide a forum for general announcements, technology presentations by local experts, sharing sessions, product information updates, and vendor presentations. TUG provided an avenue for reaching staff members who have an interest in educational uses of technology from the beginner to the expert user. Staff training occurs during the formalized meeting with technology presentations and also informally during the sharing sessions.

Project
Telpochcalli: Virtual Aztec School to Interconnect the Schools of Nuevo León

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Key Words: **Mexico, telecommunications, BBS, Telpochcalli**

Introduction

Ever since computers started to be used, greater possibilities of application were foreseen in the different fields of human activity, for example, education among others.

In the last years, computing technology has developed at an incredible speed and with the advance in telecommunications, it has become an effective and versatile means in the distance communication.

Nowadays, there are great international nets such as Internet, that help us communicate to any place of the world in order to exchange information among all social sectors, thus becoming an endless resource for teachers and students.

In order to attend the different needs from society, even from farther places, complex systems of distance education have been designed through the exchange of information, computer assisted conferences, seminars, discussion groups and consultation.

With this interest in mind, the State Department of Education in Nuevo León, through its Educational Computing Program, has initiated a Telecommunications Project. This project consists in the implementation of the educational BBS Telpochcalli. This BBS was designed to attend the needs of preschool, elementary and secondary schools as well as those from Higher Education in the State. This paper will give details about the design, implementation and operation of such project.

Telpochcalli

Telpochcalli is the name of our educational BBS. It emulates an Aztec school, mixing the Aztec architecture and environment with an actual school structure, being the space for communication, research and development of collaborative projects. Each one of the 13 areas of Telpochcalli contents a module with information about the Aztec Culture related to that area.

General Objective

Telpochcalli's general objective is to improve the quality of education by providing the Educational Community with a General Information System in order to promote the exchange of experiences as well as the access to information through the use of computers and the telecommunications.

Specific Objectives

- Motivate the practice of writing as a means of communication
- Intercommunicate distant places looking for the exchange of information and the development of collaborative projects
- Promote the cultural interchange among parents, teachers and students
- Encourage the practice of foreign languages (English, particularly)
- Provide teachers and students with access to local, national and international databases to support research
- Promote new attitudes toward a more professional educational practice
- Help decentralization of educational and administrative services of the State Department of Education intercommunicating all of its offices, regions, training centers and schools
- Develop in our teachers and students a technical, pedagogical and ethical culture of information

Risks

Just about any starting off of a project will bring with it a certain amount of risks. The analysis of the experiences in the implementation of similar information systems in other countries, has helped us reflect and value, to a greater extent, those same details in the implementation and operation of our own project. Some of those risks are:

- Not knowing the ways to access information
- Slow access speed
- Poor English language proficiency
- Delayed answer
- Spelling (stress marks on letters and special Spanish characters)
- Lack of motivation from potential users
- No management of the flow of information

Why a BBS?

Having a BBS offers the following advantages:

- Easy administration
- Friendly user's interface:
    - No commands
    - Use of menus
    - Help online
- Well-defined structure
    - E-mail
    - Forums
    - Databases
- Intuitive organization of the information

Implementation

One of the most attracting features of a BBS is the amount and variety of services that it can offer. The activities and services that Telpochcalli will offer in its first two phases are:

First Stage (pre-operation)

- Design and development of Telpochcalli
- Services:
    - Local e-mail
    - Local forums
    - Some online publications
    - Databases and file transference
    - Access by phone
    - Technical Support
- Development of local collaborative projects
- Technical and pedagogical training
- Installation of a modem in all the State Teachers' Schools and in each of the Training Centers of the Educational Computing Program

Second Stage (formal operation)

Integrating Telpochcalli into Internet Services:

- Internet e-mail and mailing lists
- National forums and newsgroups
- Some national and international online publications
- Databases and FTP
- Telnet access
- World Wide Web
    - At least one modem installed in each of the 51 State Districts
    - Development of national and international collaborative projects

Third Stage (expansion)

This stage incorporates local access to Telpochcalli from the nine Educational Districts in the State: Monterrey I, II, and III; Sabinas Hidalgo; China; Cadereyta; Linares; Dr. Arroyo and Galeana.

Project

Changing Technology Experiences: A Model For Revisioning Preservice Courses

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Key Words: **higher education, preservice education, program development, faculty development, ISTE**

It is no longer a question of whether or not technology experiences need to be an integrated part of a preservice teacher education program. The issue is what processes will best help us put those experiences in place. *Teachers & Technology*, the 1995 report from the Office of Technology Assessment, clearly identified some real concerns in the area of technology and the preparation of new teachers. Two of these findings in particular provided the impetus for this project. The report indicates that:

- graduates of teacher preparation programs are entering the field with limited knowledge of how technology can be used in their own practice;
- teacher education faculty are teaching about technology, not with technology.

The majority of faculty members currently do not model the use of technology in their own teaching, are not aiding preservice students in knowing ways they can integrate information technologies into their future instructional practice, and rarely offer opportunities for students to create lessons using these tools. In fact, curriculum standards that have been developed by content area associations include technology experiences as a part of the necessary in providing needed skills for citizens of tomorrow.

With those considerations in mind, the goal of this project was to develop a model that can assist faculty as they revise existing courses and discover ways to meet the objectives of those courses that include the uses of information technologies. The partnership for developing this process included a member of the Technology in Education Department and a member of the Mathematics Education Department. The first step in the process was to identify the course upon which we would trial the process. The Methods for Teaching Elementary School Mathematics course was chosen. As it would be offered two quarters in a row, the opportunity to explore the development of the model was increased.

It is important to know that in this elementary education program all undergraduate preservice students are required to have completed the introductory computers in education course prior to admission to the methods courses. This means that methods course faculty, when designing technology based experiences, can expect students to bring basic computer skills with them to class.

During the first quarter we reviewed the technology experiences already in place and the technology educator came in and demonstrated several pieces of software, one of these was Davidson's Math Blaster Mystery (MBM). After the students had been involved in a demonstration of the software, the mathematics educator led a discussion on how specific mathematical objectives could be met through the use of MBM. Additionally, meetings of the partners focused on how to revision the second quarter syllabus as well as the instructor and student learning experiences. This included reviewing software that would be available in light of the objectives for the course and developed four possible ways in which these experiences would take place. The partners wanted to both develop new technology experiences for the students and develop ways the instructor could model technology as his own instructional tool. With that two-pronged approach as our guide we prepared for the second offering of the course.

Plans were changed following the first meeting of the methods block faculty. As this group of four shared their plans for the quarter it became obvious that other faculty were also planning on providing students with technology-based learning experiences. We then reexamined and redesigned the mathematics methods course so there would be a minimum of overlap between courses and still insure that a variety of skill experiences were being offered.

Three specific opportunities were identified where the instructor could model the use of technology as an instructional tool. The first was to model, on his own, the use of MBM and lead the discussion as had been done in the first quarter. The second modeling experience included the use of Inspiration as a concept mapping tool in class using a computer and LCD panel. The last was to work with the technology educator to learn how to use *ClarisWorks* Slideshow and develop one slide show to be used for instruction.

The final format for the course included two technology related assignments. The first assignment focused on practitioners' current use of technology in their teaching of mathematics. Towards that end we provided students with a protocol of six questions. Each student interviewed a practitioner and the results of those interviews became the basis for an extended classroom discussion. For the second assignment students could either construct an appropriate set of problems for MBM or create an annotated bibliography of technology-based resources available, including resources accessible via the Internet, for teaching elementary school mathematics.

At the conclusion of the quarter we examined all of the technology experiences the students had completed within all four of the methods courses in light of the International Society for Technology in Education (ISTE) Foundation Standards. This was done in order to determine how well the ISTE standards were being addressed. All of these data will be used in connection with program review and development and identifying areas for faculty professional growth experiences in the technology area.

During this session we will describe the strengths and weakness of the process, share our findings and our next steps, and discuss the timeline needed. The audience will be invited to reflect on the model and offer suggestions that may be helpful to us as well at their own institutions.

Project

The Electronic Emissary: Stories of Expert-Student Mentoring in Cyberspace

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Key Words: telementoring, telecommunications, e-mail, subject matter experts

There are now more than 39 million people worldwide with access to global electronic mail (e-mail). Many of these millions are subject matter specialists whose knowledge encompasses a wide spectrum of expertise. What if connections could be made so that volunteers from among this group could communicate directly with students and teachers who are studying about the experts' specialties?

Such a service exists. The *Electronic Emissary Project* is a new type of Internet-based interpersonal resource that has been available since February of 1993, and is currently being expanded. It is based at the University of Texas at Austin, and is supported by both the Texas Center for Educational Technology and the JC Penney Corporation. The Emissary is a "matching service" that helps teachers with access to the Internet locate other Internet account-holders who are experts in different disciplines, for purposes of setting up curriculum-based, electronic exchanges among the teachers, their students, and the experts. In this way, the interaction that occurs among teachers and students face-to-face in the classroom is supplemented and extended by exchanges that occur among teachers, students, and SMEs asynchronously via electronic mail. The Emissary is also a research project, which has as its focus exploration of the nature of adult-child, text-based interaction in which students are active inquirers.

Several examples of online projects from recent Emissary-arranged matches follow.

- Adrian Kelley, who works at the State University of New York-Potsdam, posed as a young Union soldier to help gifted and talented fifth-grade students in Omaha, Nebraska learn about the Civil War. He answered the students' questions in character. The students used what they learned from Mr. Kelley's responses to write a play about the Civil War, which was performed at their school in late January.
- A high school senior in Portland, Oregon communicated with Tony DelPrete, an oceanographer and geologist at the State University of New York, about earthquakes. The student explained his plan to design a microquake detector. Topics discussed included microseismic events, non-seismic events, and compression waves.
- Fourth and fifth graders in Kansas City, Missouri, learned how to write and broadcast the news with the guidance of Vance Elderkin, a lecturer in the Department of Communications at North Carolina State University. Libby Adams, the teacher involved in the project, felt that Dr. Elderkin helped her tremendously as she began the new experience of broadcasting over an in-house network.

- Jannah, a ten-year-old student in Connecticut, corresponds frequently with Dr. Eisner, a professor in Arizona. They continued their study of Arthurian legends that begun in the spring semester of 1995 during both the summer and fall semester of 1995, and plan to study together indefinitely. This spring, Jannah, Dr. Eisner, and Barb Sanchez, the *Emissary* facilitator, are co-authoring an article describing their online educational experiences.
- 17 seniors at a high school in Windsor, Connecticut, discussed international current events and researched global issues with the help of B. Welling Hall, a political science professor at Earlham College in Columbus, Ohio. The focus of the project involved looking at several different conflict situations and establishing criteria which the US might consider before intervening.
- 19 fourth- and fifth-grade students in McAllen, Texas, compared the experiences of their families on the Texas "La Frontera" to colonial life in the original 13 US-colonies, with the help of John Pearce, the director of a historic preservation center and museum in Fredericksburg, Virginia.
- An Advanced Placement Spanish Literature class in Ross, California communicated with Bob Fritz, a professor of Spanish at Ball State University. All communication was conducted in Spanish. Topics addressed included the nivolas of Miguel de Unamuno and how these works fit into the cultural and historical context of Spain.
- Mellie Lewis' 25 third-grade students studied the ecology of the Florida Everglades. Michael Rose, a scientist at the South Florida Water Management District, provided expert information to the students. The main topic of the exchange was "water conditions of southern Florida." The goal of the project was for students to learn about the interdependency of Lake Okeechobee, the Everglades, and Florida Bay, and also to learn about man's impact on these environments.
- A home-schooled child in Georgetown, Texas communicated with Dr. John Merwin, an anesthesiologist in Missouri, about the effects of anesthesia on the body, surgical procedures, and human anatomy. Dr. Merwin enjoyed being able to share some of the knowledge that he has gained over the years with a student who was so eager to learn.

During this project presentation, the ongoing *Emissary* project will be described briefly, an update on matching services available will be given, and a variety of stories of expert-student interaction will be shared, in an effort to communicate the power and variety of interaction that has occurred among experts, students, and teachers via the Internet.

Students and teachers of the Information Age need to be able to make connections outside the geographic and temporal bounds of their communities. Their mentors should include subject matter and pedagogical experts from both down the hall and around the globe. The *Electronic Emissary* is an effort that assists teachers and learners in addressing these needs and that vision.

Project
Beyond Surfing: Telehunting, Telegathering, and Teleharvesting* on the 'Net

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Key Words: teleresearch, Internet, information access, constructing knowledge

Six months ago, the Internet offered us approximately 10 million hosts, or computers to which one could connect to access information. The Internet has been growing at a rate of approximately 100% per year since 1988 (MIDS, 1996). One estimate says that a new Internet host is added about every 30 minutes (Calcari, 1994). Obviously, there is a lot of Internetworked information to which we and our students have access, and that amount is growing quickly.

But merely accessing information should not be confused with constructing knowledge. The making of knowledge is an active, holistic, and idiosyncratic process for each learner that can be greatly enhanced with a teacher's guidance. Information accessed using the Internet can become some of the elemental substances used by learners to create knowledge, much in the same way as air, water, and light are used by a plant in the process of photosynthesis. Unlike the production of chlorophyll, though, the production of knowledge often benefits from direct, interpersonal assistance. As teachers, we know that it is our responsibility to provide this guidance to our students. Yet, with most of us being newcomers to the overwhelming amount and variety of information available online, how can we know how to do this?

Telehunting and Telegathering

The usual answer to this question is technological...and insufficient. Information searching programs, such as *Veronica* in Gopherspace and the variety of search engines, such as *Lycos*, on the World Wide Web, are certainly powerful, useful tools that can help our students to locate large numbers of diverse and timely documents. In schools with the luxuries of easy access and flexible class schedules, students (and teachers) happily "surf the Internet," often impressed with the range, amount, and appearance of all that can be found that is related to a particular area of inquiry. In a sense, we become Information Age hunters and gatherers in cyberspace, sharing news of the richest locations by exchanging addresses and URLs with members of our virtual clans. Yet it is here, at the point of information access, that many current knowledge-creation efforts falter. We find ourselves confronting a much more important educational issue: what students *do* with the information once they locate it. This is the step at which mechanical assistance cannot replace human interaction.

In prehistoric terms, how can the fruits of the hunt be turned to food for the clan? Part of the answer to this question lies in the plan for information seeking itself. If students know clearly how they will use the information that they eventually locate, their chances for purposeful searching, rather than aimless surfing, increase. As teachers, we can help our students to formulate and enact these plans. My virtual travels on the Internet have revealed five purposes that students seem to have (often at the apparent suggestion of their teachers) when engaged in such "virtual foraging." I will share them with NECC '96 attendees with hopes that knowing these categories will assist their online educational activity planning. At this point in time, the purposes for information-seeking on the Internet that reports of K–12 students' projects have seemed to suggest are:

1. To practice information-seeking skills
2. To inform oneself about a topic of inquiry and/or answer a question
3. To review multiple perspectives on an issue
4. To help students solve an authentic problem
5. To publish synthesized and/or critiqued information overviews for other students to use

To illustrate each, I will use several examples from online projects that were designed by teachers, classroom-tested, and freely shared with the global Internet educational community.

Teleharvesting*

Those of you raised in urban environments might be surprised to learn, as I was, that crop harvesting is not comprised primarily of the collection and bundling of mature plants. Instead, it involves mostly the *processing* of gathered crops, getting them ready for sale or consumption.

The same is true for teleharvested information, which has been remotely cultivated, perhaps by groups of K–12 students and their teachers. The effective processing of Internetworked information—that is, its use by learners in the construction of knowledge—is a principal challenge to learners and teachers in the Information Age. Like the ancient farmers who invented agriculture, we have much to learn, and ultimately share, about the art and practice of "infoculture."

References

Calcari, S. (1994). A snapshot of the Internet. Internet World, 5 (6), 54–58. MIDS: Matrix Information & Directory Services (1996). Sizes of the Internet in October 1995, from the Third MIDS Internet Demographic Survey. Matrix News, 6 (1),1,5.

* I am indebted to my friend and colleague, Cathy Gunn, a faculty member at the University of Northern Arizona, for her creation of this insightful concept and term.

Paper

Taking the Mystery Out of Research in Computing Information Systems: A New Approach to Teaching Research Paradigm Architecture

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Key Words: **research, paradigms, icons, structured design, object design**

Abstract

In senior-level undergraduate research courses in Computer Information Systems, students are required to read and assimilate a large volume of current research literature. One course objective is to demonstrate to the student that there are patterns or models or paradigms of research. A new approach is proposed to aid the student in identifying the research paradigms. The new approach is based on the use of the modeling tools of Systems Analysis and Design and a set of icons to graphically represent the author's model of research.

Background

In the undergraduate course in Computer Information Systems (CIS) Research, the primary resources used are the professional journals and conference proceedings. Due to the expanding interpretation of the boundaries of the field, the amount of literature that is encompassed within the CIS curriculum can be overwhelming. The student may consider it all but impossible to keep abreast of developments in so many directions, and the likely course of action is that the student restricts themselves in the number of directions of interest. This recourse, however, can be self-defeating in that the richest discoveries have come from the cross-fertilization of interests, especially in the area of theory formulation. Therefore, a newer approach is needed to help the student better manage the process of gaining control over the flow of information about the research process.

Numerous journal articles and conference proceedings were analyzed, ranging from conceptual to applied to empirical research. Academic researchers were interviewed about their cognitive research models. From this work, it became apparent that there are basic similarities in the models the authors used in conducting and publishing their research. The intent of this paper is identify a number of the similarities and categorize the cognitive processes into discrete paradigms (as used in the Kuhnian sense) or models of research. The working hypothesis of the paper is that there are a finite number of concrete research paradigms that are used, often without the researcher realizing he or she is using them.

It is felt that the concrete models can be structured into architectures, thereby providing macro maps of the objects, actions, attributes and flows within the mystery land of Research. The architectures can be used by the student to group and classify existing paradigms. The benefits from such classification would be many, including identification of gaps, patterns and shifts in research models.

In summary, the newer approach to taking the mystery out of research is to identify the research paradigms currently used in the CIS literature, demonstrate how the paradigms can be used as basic elements, and how the elements can be framed into different architectures of the research process. The newer approach will provide a cognitive structure for research that could help the student focus their creativity on solutions, while the disciplinary courses provide the student with a structure of problems to be solved.

Research Paradigms and Their Representation

Research occurs at three broad levels. At the lower level of the pyramid are the disciplinary or exemplar paradigms, such as the paradigms of Economics, Marketing, Physics, Biology, etc. At the middle level of the pyramid are the paradigms that encompass a higher level of generalization, such as the broad paradigms of the social and physical sciences. At the highest level of the pyramid is a set of more universal research paradigms. The newer approach takes the top-down method of analyzing the overall system of research models and their architectures, and this requires an initial concentration of the top-level, encapsulating paradigms.

At the top level of the pyramid, the research process would include actions such as modeling, describing, theorizing, prescribing, proving, synthesizing, testing, solving, demonstrating, verifying, categorizing, and so forth. At the lower level the upper level actions would be operationalized into case studies, field studies, laboratory experiments, field experiments, and other paradigms of the CIS discipline.

At the top level, because of the lack of consensus and the imprecision of construct definition, it is more difficult to find acceptable representations or words to describe the research paradigms. At the lower level, because of the existence of consensus and the precision of construct definition, ideas can be readily translated into words with common meanings.

Representing Research Constructs with Icons

Icons give a generalized picture of the objects, the actions they take and their flows. Together, the icons can be grouped into larger frames or architectures that represent different models for conducting research in CIS.

Icons were selected as the Esperanto of the language of research models, since they are more independent of semantic representations than text. At the top level of the research pyramid the representation should be as context-free of domain specific language as possible so that the representation can be applied to many disciplinary areas.

Icons provide a richer, concrete representation of fuzzy constructs than text, and images, as pointed out by Aristotle, are the basic building blocks of thought. Think of how much easier it is to teach the statistical concepts of unions, intersection, and complements with Venn diagrams than with words.

Top-Level Research Paradigms in CIS

Based on the literature review and the interviews conducted for this study, a number of candidates appeared as top-level research paradigms. There are (but not limited to):

A. Formulation of new theory or hypothesis based on one's own research or generating theory or hypothesis through synthesis or generalization of another's research

B. Building models to solve existing problems and demonstrating how the models solve a class of problems

C. Applying existing models to new areas of application

D. Building frameworks or taxonomies to organize or inventory knowledge

E. Cross-fertilization or transfer of knowledge (theory or technique) from one discipline to another

F. Generalizing existing knowledge to higher levels of abstraction or to larger classes of problems; generalizing existing solutions to a totally different class of problems

G. Using inventories of knowledge as a base to demonstrate trends and make predictions

H. Identifying shifts away from a generally accepted research approach to a newer approach

I. Popularizing ideas and putting them in concrete form

J. Comparing practice versus theory, real versus ideal, or observed versus predicted

K. Delimiting gaps in knowledge, gaps between practice and theory, gaps between problems and solutions, gaps between the real and the ideal, or gaps between observed and predicted

L. Taking old concepts, filtering them and creating new concepts

Each of the paradigms above can be described by a series of interconnected icons representing the components of the model. The icons can be developed by the students themselves. For example, an icon of a library or book can be used to represent "theory," and an icon of a factory can be used to represent "practice" in the paradigm numbered "J" above. "Cross-fertilization" can be represented by an "X" in paradigm "E." An icon of a house being framed can be used to represent "building frameworks" in paradigm "D." A ladder can be used to represent paradigm "F." "Making predictions" in paradigm "G" could be represented by a crystal ball.

The components of the research model, as illustrated by the icons, can be subdivided into lower and lower levels. For example, the student can develop icons for lab experiments (a test tube or microscope, for example), questionnaires ("?"), and so forth.

Using Modeling Tools to Represent Research Models

One method for understanding the components and their relationships for a particular paradigm would be to apply a traditional functional decomposition method (such as with Data Flow Diagrams, for example) to the abstract model, much as the student has been taught in the Systems Analysis and Design course. In this approach, the processes would be successively decomposed into finer and finer grained modules. Another method for understanding the models would be to apply the object-oriented approach, in which the paradigm architectures consist of objects that are differentiated could be represented as in Figure 1.

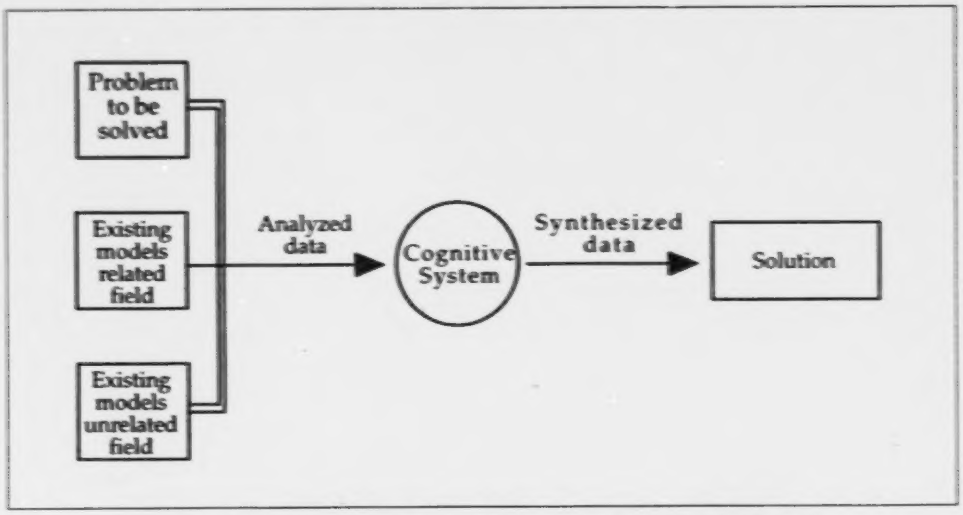
Problem to be solved
Existing models related field
Existing models unrelated field
Analyzed data
Cognitive System
Synthesized data
Solution

Figure 1. Top-level Data Flow Diagram of Research Model

In both the object and the functional approaches, the next step is to develop a lower level diagram, such as a data flow diagram as proposed by Tom DeMarco, Edward Yourdon, Chris Gane, and Trish Sarson. For example, this diagram (Figure 2) could appear as:

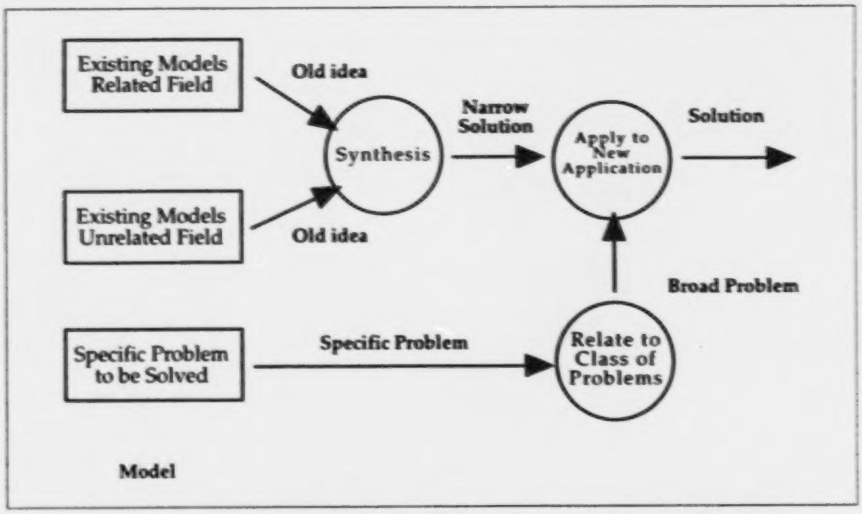
Existing Models Related Field
Old idea
Synthesis
Narrow Solution
Apply to New Application
Solution
Existing Models Unrelated Field
Old idea
Broad Problem
Specific Problem to be Solved
Specific Problem
Relate to Class of Problems
Model

Figure 2. Lower-level Data Flow Diagram of Research Model

With a functional decomposition approach, the next step is to create a structure chart, such as developed by Edward Yourdon. However, the concept of modules and rigidly defined hierarchies of modules connotes a level of precision in definition that we are assuming doesn't exist for the student. Therefore, rather than applying an algorithmic decomposition approach, the student could then apply the object-oriented approach, with potential benefits to be repeated beyond the "design" stage.

In the object-oriented approach, our systematic approach to the analysis of research is decomposed into objects and messages. An object-oriented decomposition diagram or Booch Diagram of our problem domain could look as follows (see Figure 3):

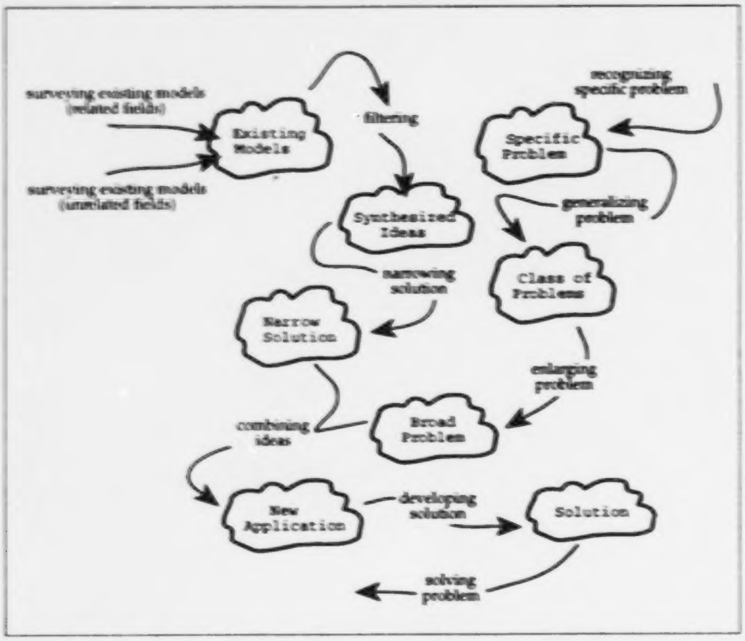
surveying existing models (related fields)
Existing Models
surveying existing models (unrelated fields)
filtering
recognizing specific problem
Specific Problem
Synthesized Ideas
generalizing problem
narrowing solution
Class of Problems
Narrow Solution
enlarging problem
combining ideas
Broad Problem
New Application
developing solution
Solution
solving problem

Figure 3. Object-oriented Decomposition of Research Model

At this point, icons can be applied to the objects and messages. The following icons are used for this research model are shown in Figure 4. The icons were taken from the CorelDraw Clip Art Library, rendered with *Poser*, resized with *Freehand*, and the layout was done with *QuarkXpress* on a Macintosh computer.

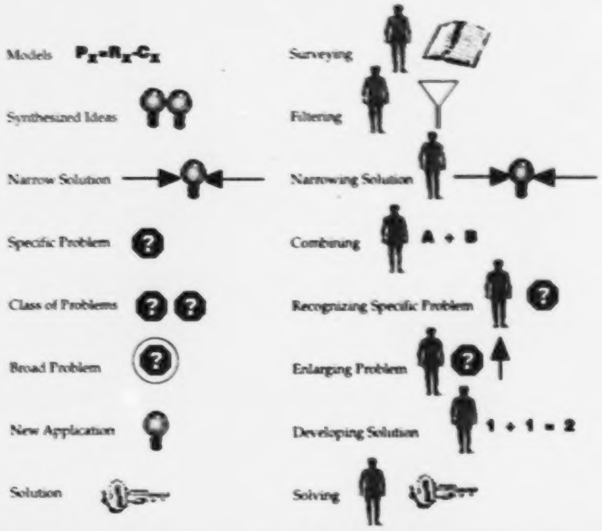
Models
$P_x=R_x-C_x$
Synthesized Ideas
Narrow Solution
Specific Problem
Class of Problems
Broad Problem
New Application
Solution
Surveying
Filtering
Narrowing Solution
Combining
A + B
Recognizing Specific Problem
Enlarging Problem
Developing Solution
1 + 1 = 2
Solving

Figure 4. Icons Used in Representing Research Model

Repeating Figure 3, the basic architecture of the research activity, using icons, would appear as Figure 5.

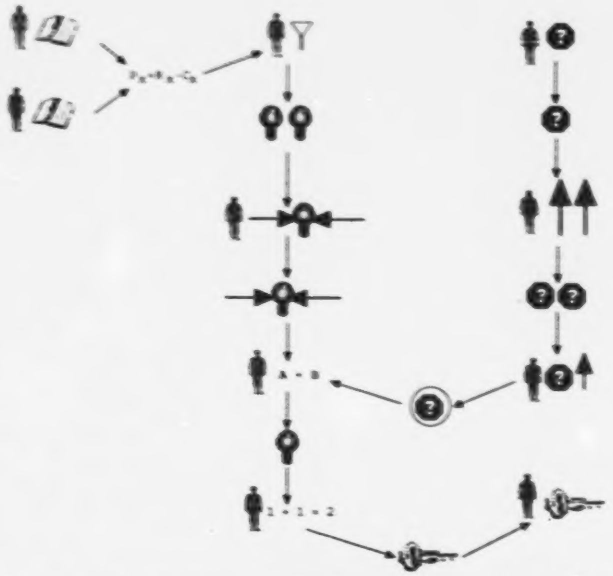

Figure 5. Iconic Representations of Research Model

Conclusions

The newer approach to defining research paradigms, combined with an object-oriented methodology for representing the architecture, provides a macro level series of slices through the research process. The slices or frames or packages, in turn, can be subdivided into finer-grained architectures.

It can be envisioned that the student will gather a large number of templates (such as in Figure 4) as he or she goes through the successive decomposition of the different levels of research for different journal or conference papers. It can be envisioned that the student can gather a number of icons and link them together to design a framework for the student's research project. The process of decomposition should expedite the student's appreciation of the similarities and differences of research models and thereby aid that student in managing the explosion of published research within the CIS field.

References

Booch, G. (1991). *Object-Oriented Design with Applications*. Redwood City, Calif.: Benjamin/Cummings.

DeMarco, T. (1979). *Structured Analysis and System Specification*. Englewood Cliffs, NJ: Prentice-Hall.

Gane, C., & Sarson, T. (1979). *Structured System Analysis: Tools and Techniques*. Englewood Cliffs, NJ: Prentice-Hall.

Kuhn, T. (1970). *Structure of Scientific Revolution*. Chicago, IL: University of Chicago Press.

Meyerowitz, D.(1994). Signs and symbols: Visual Communication. *Whole Earth Review*, 82(2),48.

Scannell, T. (1988). Objects and Icons Beget "New Wave" of Programs. *Mini-Micro Systems*, 21(1), 21–26.

Shirk, H.& Smith, H. (1994). Some Issues Influencing Computer Icon Design. *Technical Communications*, 41(11), 680–689.

Wellman, T. (1985). The Advantages of Icons in Locating and Retrieving. *Office*, 101(5), 122–156.

Wetherbe, J. & Vitalari, N. (1994). *Systems Analysis and Design: Best Practices*. St. Paul/Minneapolis: West Publishing Co.

Yourdon, Edward. (1989). *Modern Structured Analysis*. Englewood Cliffs, NJ: Yourdon Press.

Focus

HyperInternet™—Creating TRULY Interactive Reports and Presentations

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Key Words: **multimedia, writing, Internet, HyperStudio, interactive**

HyperInternet™—Active Internet Access Embedded Within Multimedia Writing

The process of multimedia writing has not decreased in complexity since the first slide shows. While it's true that you no longer have to be a BASIC programmer to display graphics on the screen, nor do you have to be a HyperTalk or *Lingo* master to make connection sequences (buttons), the software of today requires a great deal more planning for proper use of available options. Even though it's easier to do most tasks with today's software when compared to the techniques of even five years ago, the number of tasks that the software is capable of doing has increased to the point where much time is spent learning the software rather than concentrating on content. Add to that fact that many schools are now offering Internet access for information and you've just introduced the variable that might push multimedia writing back to a single dimension—the print medium.

How does the above fit in with the notion of *HyperInternet*™ (or Intermedia if you'd rather)? First, the idea that staff and students should be constrained to single sources of electronic media should be long gone, even in desktop publishing. In other words, why restrict a student or staff member to using only sounds or graphics that come with a program; why restrict them to only CD-ROM resources; why restrict them to only textual telecommunications data? If the software you and your students use to create multimedia writing doesn't allow for the easy integration of multiple file formats, perhaps you should consider a different package. Second, data coming from CD-ROMs, digital cameras, scanners, videodiscs, software clip art and sounds is, by its nature, static. The data won't change so the multimedia writing will always keep its original content—

even if it's meant to be a "living" document. *HyperInternet*™ is the process of creating multimedia writing that can change as the information referenced changes. The process also must allow for the use of file formats common to the Internet. The Internet, whether using material created locally or from a remote site, gives us the opportunity to finally publish information electronically using a moving target. *HyperInternet*™ simply involves the creation of electronic publications where data of almost any format can be integrated and links can be made locally, remotely and globally. This session will demonstrate how all of that can happen in a straightforward, easy to use and teach method with the software package *HyperStudio*®. First, we need to consider the wide variety of data formats that the Internet has to offer, then we'll look at three distinctly different methods in which *HyperStudio*® allows us to access Internet resources.

Since the whole point of having access to the Internet for staff and students is to increase the amount and the timeliness of accessible information, it only makes sense to encourage them to use those resources directly in their reports and presentations without making them part of the "static" information "burned in" on the electronic publication. The methods demonstrated in this session should give participants a start on helping other staff and students to create their first "Intermedia" report or presentation and joining the realm of *HyperInternet*™—creating *truly* interactive reports and presentations!

Project

Pressing CD-ROMs to Promote Faculty Development in Use of Technology

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Key Words: CD-ROM, faculty development, technology

Faculty in the School of Education at the University of South Dakota are becoming skilled in the design and production of CD-ROMs. The final products are being used for instruction in their classes, as well as for their research and service projects. This opportunity for faculty has been made possible because of the research and development initiative in the School of Education focusing on interactive multimedia.

Faculty members are selected from each of the four Divisions in the School of Education and assigned to the Center for Interactive Technology in Education and Corporations (InTEC). As part of their regular duties, those faculty members spend time enhancing their skills in designing instructionally-sound materials. As part of their professional development they are also challenged to learn how to use new and emerging technologies. As part of the overall experience, faculty are expected to be involved in pressing an interactive CD-ROM which can be applied to an area of study or content specialty.

Successes and failures relative to faculty development in the use of technology have been experienced as a result of this initiative. Despite the primary problem of lack of time associated with such skill enhancement, many faculty members in the School of Education have utilized their new technology skills to produce CD-ROMs relevant to their specific content areas of expertise. Faculty have also collaborated with others from academic units across the campus to produce interdisciplinary applications which promote learning. Multimedia projects have also extended beyond the traditional campus to involve schools and businesses throughout the state of South Dakota.

In summary, the ability to integrate new technologies into the classroom has provided new avenues for faculty at the University of South Dakota in their pursuit of excellence in teaching, research, and service to the profession. Overall, this plan of faculty development has also benefited the School of Education in meeting its commitment to the promotion of rural schools advancement and economic development through the use of new and emerging technologies, such as the CD-ROM.

Project
The Art of the Possible: A Global Curriculum Telecommunications Project in Jerusalem

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Key Words: **global curriculum, telecommunications, international, Internet, I*EARN**

Among the challenges facing the educational community is how to prepare students for participation in an interdependent world community. As our world changes and we embark upon the information age, the lecture-recitation textbook driven model of teaching and learning is no longer an adequate pedagogical approach for preparing students to participate in the global community. Students need new tools and new methods for viewing and handling information as we move forward to make the world a more humane place. Communication must be a major objective in developing a new paradigm of teaching and learning designed to foster understanding and co-existence in today's interdependent world.

Building Global Communities—Making Global Connections, a global curriculum telecommunications project, uses technology—specifically the computer and the Internet—to encourage communication and support curricular change in an eighth grade class at St. Dimitri School, Jerusalem. St. Dimitri school is a small Orthodox Christian co-educational school operated by the Greek Patriarchate of Jerusalem.

St. Dimitri is unique in many aspects, including location in the Old City of Jerusalem, no previous computer ownership and curricular upheaval due to political changes in the region. Rarely do we have the opportunity to see what happens on "the other side" of international telecommunications projects. The obstacles faced by our international partners remain shrouded in mystery. Our project offers a window to the other side—the cultural implications of introducing telecommunications as well as the day to day realities of the project.

Our presentation will describe the often overwhelming obstacles encountered on the road to success during the design and implementation of Building Global Communities—Making Global Connections. Issues surrounding connectivity, curriculum materials, teacher training, and goals of the curriculum unit will be addressed. June Idzal, the Computer Director for the Calhoun School, our partner, and Amal Behnam and George Maria, the teachers involved in the project at St. Dimitri, will share their experiences.

Project
Interactive Laboratory Exercises for Meteorology

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Key Words: **educational technology, meteorology, digital libraries, science education, laboratory exercises, distance learning, Internet**

Meteorology is a highly visual and empirical science. Regardless of the academic level, students must be able to visualize and analyze data that are often real-time and perishable, such as the current weather map. To this end, they should experience hands-on laboratory investigations. The computer as a tool in student activities has several educational advantages. However, introductory meteorology courses at the college level often suffer from a lack of instructional laboratory materials emphasizing practical applications with the computer used in data analysis and other applications. Often, the available exercises have too much theory, are too contrived or represent canned exercises that do not stimulate scientific curiosity in the student. Current weather data is not always employed. The use of computers is not always encouraged, a critical omission for those students who hope to become scientists or engineers and will have to become versatile in using computers.

To help solve these problems, a suite of interactive laboratory exercises with computer-based investigations including supplementary materials such as instructors' manuals is under development for use in college-level general education and professional gateway courses. These exercises are an extension of the EarthLab Learning Environment, a software system for hands-on education in the earth-related sciences presently under development by Ross Computational Resources (RCR) that takes advantage of computer simulation, scientific visualization, hypertext and digital library techniques. The software being developed would let the student perform a variety of operations on the data, including animation, rotation, display of multiple layers at different levels of the atmosphere, different types of plots, and various vertical cross sections.

In this first phase of the project, the lessons being developed include vector analysis, wind vector applications, data analysis, solar illumination geometry and water budgets. These lessons are being created at more than one level of difficulty with several potential user groups in mind: undergraduate students in introductory earth science and meteorology courses; students in distance learning or extension courses; secondary school students in earth science, physical science or integrated science programs. Several of these lessons will be evaluated by students and instructional staff in undergraduate meteorology education at the University of Wisconsin-Madison during 1996 as well as by some of the high school earth science education participants from the EarthLab project.

Some lessons will use current weather and climate data from the Internet. Connection to the Internet allows the instructor or the student to access and incorporate current weather data. This capability is important for several reasons. The ability to capture large data sets on a near real-time basis is important where time-perishable data are used. Additionally, for many students the access to real-time or near-real-time data for the subject at hand makes the exercise much more exciting as for example in the use of current weather data to produce a short-term forecast. In meteorology, this opportunity provides situational awareness and helps develop rapid forecasting skills for those who anticipate becoming operational meteorologists.

After completing the assigned lesson, the students can explore further, posing additional problems of their own and playing with "what if" scenarios using real-time weather data, case study data, simulation, simple visualization, and other learning resources possible in a computer environment accessing the Internet. The multiple levels for each exercise will provide instructors a choice for assignments and will provide students an opportunity to work from a simpler version to a more complex one. These lessons will have links to the EarthLab digital library, also structured in levels of difficulty, including glossary, help sessions, additional mathematical appendices, library articles and supplementary interactive lessons, available as a resource while students complete the assigned lesson or explore further posing their own problems to solve.

The prototype lessons and required software are being developed on a DOS based platform and will be initially provided as Web pages for trial use. A home page with links to local and national weather servers was produced. Ultimately, the suite of exercises will be designed to be run on various types of computer platforms, with the view of making the package more usable by institutions that have other computer systems.

The project presentation will describe the design of the complete suite of lessons and digital resources, explain the motivation for the levels of difficulty, demonstrate one or more lessons and their interactions with the digital library, and report on the results of the evaluations to be conducted during 1996.

Focus

Community Partnerships: How They are Formed and How They Work

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Key Words: **partnerships, community, networks, media retrieval, distance learning**

When our ancestors set out to blaze a trail into unmapped wilderness the partners they took along meat the difference between success and failure. The same is true today as we blaze new trails into the frontiers of educational technology. The initial project at Greenwood Middle School was to set up a local area network and a media retrieval system in the school. A committee of middle school staff, parents, and students was organized to explore what type of technology would be installed. Student input was important during this process because, any technology installed would depend heavily on student help for maintenance and management. It was during this phase that the first partnerships between Greenwood Middle Schools and the private sector were formed.

Most US schools ask business to contribute equipment or money without ever thinking about what benefit the business can receive out of the arrangement. They assume that a tax break is all that the business need. In the schools' defense the idea of looking for a handout should not be blamed totally on the school. If you have ever been to an educational trade show most of the exhibitors are "giving" away anything and everything. As Greenwood Middle School embarked on this project, several companies became business partners rather than simply vendors supplying equipment and services.

After talking to several major media retrieval companies, the only company that wanted to form a true partnership was AMX Corporation and their local distributor Allied Telecommunications. After a survey of the infrastructure, or lack of it, at the middle school, obviously a cable company would have to be added to the group. Clawson Communication was chosen for this part of the project. The different companies act as advisor to the school. In exchange the school tests new technologies and acts as a place where the business partners can bring prospective clients to view educational technology in a real life environment. None of the technology at the middle school has been a complete donation. This is important because financial commitment form the school shows that the school is committed to the partnership and not just looking for a handout.

Greenwood Middle School was constructed in the 1940s, and renovated several times. The staff at the middle school is also experienced with many having over fifteen years in the education profession. These two factors are important because innovated technology projects are no good if they cannot be replicated. Another important factor is that any technology added to the middle school has been added to enhance the curriculum. The Middle School believes that the curriculum must drive the technology and not let the technology drive the curriculum.

As the success of the project became known in the community other organizations approached the partnership to join. The Greenwood Public Library, and Our Lady of the Greenwood, the local parochial school, are two local partners that have been added. All partners agree with one idea. This is that in the future the main difference between people will not be financial wealth but information wealth. The library and the parochial school insure that all members of the Greenwood community will have access to information. Ameritech will supply the partnership with the ability to video conference for distance learning, The library and the parochial school are connected by fiber to the middle school. The AMX media retrieval system will view both institutions as "rooms" in the middle school. This will make all services available at the middle school also available at theses institutions.

The distance learning that will take place, will not for the most part be a teacher at a remote location teaching a class in Greenwood. The partners in the project are aware that this type of distance learning was not successful in the past and will not be successful now. Instead students in Greenwood will become partners with students at remote locations. The students will work in collaborative teams with the students at the remote locations on various projects. The student will communicate with each other using both e-mail and video conferencing. At times experts in the field of study will be asked to join the network to "consult" with the students on a project they are working on. Experts from these locations will serve as online consultants and partners to the teams of students. The network will also be use for students to take electronic "field trips." These ideas' emphasis another belief of all the partners that school is no longer four walls but it is the entire world. When the network is not being used by the school, it will be made available, for a fee, to all members of the Greenwood community. Some uses already requested by the private sector for the video conferencing facility are, business for product seminars, professional inservice, and for grandparents to talk to grandchildren in remote locations. Besides the video conferencing supplied by Ameritech, a satellite downlink has been added to the network. When necessary by using the school's downlink and the Ameritech network to reach an uplink at a local university, or a codec at Ameritech's central office interactive video can be archived with almost any location.

Where are we going? The next step is to join the rest of the Greenwood schools to the network. Because of the Ameritech "Opportunity Indiana" links school in the Ameritech service are together, it is unnecessary to link the Greenwood project with neighboring school districts or communities. It is the intent that this project will supply all the members of the Greenwood community with the necessary tools to search for and gather information. The project should insure that the Greenwood community a community of "haves" and not "have nots" as we continue to travel in the information age.

Project

Transforming Newton's Apple: The Path from Television to New Technologies

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Key Words: **computers, multimedia, educational television**

The *Newton's Apple* television program is now in its 13th year on nationwide Public Television. *Newton's Apple* is a family science program that is widely used in K–12 classrooms. In the last four years, the producers of the program, KTCA-TV in St. Paul, have extended the program into a range of new technologies.

A level III interactive videodisc curriculum was developed under a grant from the National Science Foundation, in partnership with the National Geographic Society's Educational Media Division. The first two volumes in this series were released early in 1995, and a series of six more volumes are in development. Critical technical questions associated with the development of this product include the migration of video-based classroom materials from videodisc to CD-ROM, and the functionality of a customized videodisc authoring system.

A CD-ROM series, What's the Secret, was developed in partnership with Iconos, a Minneapolis software development company, and 3M Learning Software, a new division of the 3M Company created to launch this CD-ROM series. A myriad of technical and pedagogical questions were addressed in transforming the *Newton's Apple* television program into a truly interactive learning experience.

The educational materials supporting the television series have been released in various online formats, including a Web format through the AskEric service. MNOnline, a new service being launched by KTCA-TV and a number of other partners, will include an expansion of the *Newton's Apple* offerings for both families and educators. Adapting the existing multimedia products into online forms presents yet another challenge, technically, pedagogically, and financially.

A major theme in transforming science-literary subjects today are the new national Science Standards, released in late 1995. Implementing the appropriate principles of the Standards is yet another challenge addressed in the new *Newton's Apple* products.

The Project Session will be presented by Dr. Richard Hudson, Director of Science for KTCA-TV, and Executive Producer of the *Newton's Apple* science products.

The presentation will showcase examples of all of the above products, exploring the problems each new technology presented and the solutions arrived at.

Project

Activities and Lesson Plans for Integrating the Internet Throughout the Curriculum

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Key Words: **Internet, telecommunications, activities, lesson plans**

The Internet can offer educators instant access to educational research, curriculum sources, lesson plans, online experts, discussion groups, and teacher forums. It can provide students with resources they might not otherwise have, open doors to multicultural education, establish real-world learning experiences, invite higher order thinking skills, and can provide purposeful and motivational learning activities. This new wealth of information is opening doors for teacher collaboration, changing the way teachers teach, and influencing what teachers teach in a manner that benefits both the teacher and the student. Providing guidelines, assistance, and sample activities in the use of telecommunications are some of the ways to help educators become more familiar with the many possibilities of using the Internet as an instructional resource.

The authors have developed a variety of activities and lesson plans to assist educators in exploring and integrating the use of the Internet throughout their curriculum. The activities and lesson plans have been designed to use the Internet as an instructional tool, encouraging educators and students to participate in world-wide and timely events, data gathering and analyses, and cross-cultural exchanges. Activities have also been created to teach learners how to use a particular site. Sample lesson plans and activities include "Learning About a Rain Forest," "No Joking, Quit Smoking," "Teleportation," and "Mission to NASA."

"Learning About a Rain Forest" is a lesson plan that points teachers to rain forest Internet resources and provides guidelines for incorporating these resources into a unit about rain forests. "No Joking, Quit Smoking" is a lesson plan designed to provide students with real-world, current, and personal information about the hazards of smoking. The lesson plan provides Internet sites for learning more about the dangers of smoking, communicating with health experts, and examining perspectives of people who choose to smoke. Using the lesson plan "Teleportation," teachers help students combine published and collected data from the Internet to draw conclusions about life in another country. Students learn to question and analyze data, comparing it to personal accounts about living in another country. "Mission to NASA" is an adventure, detective

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activity that encourages problem-solving and cooperative learning while students learn about the resources that are available at the NASA Spacelink Internet site. In addition to learning about the site, students learn space facts and other information that can be tied into extension activities. Extension ideas are included in each activity and lesson plan.

The authors have assembled many of these lesson plans and activities into a book, "The Internet and Instruction: Activities and Ideas," published by Libraries Unlimited. Designed in a reproducible format, the lesson plans and activities cover various sites, access methods, and student grade levels. The lesson plans and activities are divided into four categories—Science and Mathematics, Language Arts, Social Studies and Geography, and Music and Art—and stress the integration of different subject areas. In addition to lesson plans and activities, the book also provides a list of World Wide Web sources for each category and contains integration ideas. For educators just learning about the Internet, the first few chapters cover telecommunications basics, educational issues of using the Internet, and educational applications for the Internet.

Concrete examples and models of how technology can be effectively integrated into the curriculum are a necessity if educators and students are going to reap the benefits that technology has to offer education. This is especially true for telecommunications. As more and more educators connect to and explore the many facets of the Internet, more and more educators will become overwhelmed with the many resources and the amount of information available on the Internet. Organizing this information takes time, and time is a scarce commodity for most educators. Examples and models of how to use the Internet as an instructional tool are ideal for preservice teachers, also, especially if we want beginning teachers to have experience or background in effective technology integration throughout the curriculum.

The presence of the Internet creates a new paradigm for finding, sorting, and deciphering information, and it invites opportunities to create real-world, interactive, dynamic learning environments. Pre-designed lesson plans and activities are one way to assist educators with learning about and implementing the Internet as an instructional tool throughout their curriculum. Through models, educators can begin building their own activities and lesson plans that address specific areas of their instructional needs.

Project

Dare to Be Adventurous: Creating Desktop Problem-Solving Adventures Using Microsoft Works 4.0

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Key Words: **problem-solving, Microsoft Works, Desktop Adventures, NCTM, integrated software packages, mathematics**

Included in the National Council of Teachers of Mathematics (NCTM) standards is an emphasis on problem-solving, communication, and integration of mathematics across the curriculum. NCTM recommends that problem-solving be the central focus of the mathematics curriculum, and that children express mathematical ideas verbally as well as through pictures and writing. NCTM stresses real-world learning and the value of technology. This project presents an innovative approach for developing and presenting problem-solving scenarios for use in the one computer classroom and for cooperative group instruction. The resulting activities are called *Desktop Adventures.*

Desktop Adventures are designed to help teach students to apply a variety of problem-solving strategies. Developed in *Microsoft Works 4.0* as part of Microsoft's Partners in Education Program, *Desktop Adventures* incorporate the NCTM Standards, help facilitate cooperative learning, integrate a variety of subject areas, and add a new dimension to integrated software packages. The introduction and narrative (clue) components of a *Desktop Adventure* are entered into the word processing feature of *Microsoft Works.* The database, spreadsheet, drawing, and communications features can be incorporated to provide students with opportunities to use their research and data manipulation skills. Because the problem-solving scenarios are created by the teacher (and eventually the students), they can be developed for particular grade levels, student abilities, and incorporate current areas of study. The activity gives full control to the teacher in its design and implementation.

To create a *Desktop Adventure,* it's a good idea to have a theme in mind and begin with the final solution. For example, after reading the clue components contained in the word processing documents and manipulating, gathering, and synthesizing the information contained in a database, the students will determine the three numbers that represent the combination to a family safe. In this example, the creator has determined that the final solution will be three numbers and the theme will be based on an adventure that leads the participators to a family safe (see "Desktop Adventuring," *The Computing Teacher,* 1992). After deciding upon a theme and a final solution, the creator develops a series of interdependent clues that will lead the user to the final solution. The user must accurately decipher and solve the problems or puzzles contained in these clues to arrive at the final solution. Clues are interdependent to re-enforce the idea that problem-solving can involve many steps and is not necessarily a linear process. In addition, some problems may not make any sense because they lack necessary information. For example, a clue may refer to a secret formula or other information that the student may have to find or solve elsewhere.

The following example is from a clue presented in "Family Heirs," a *Desktop Adventure* that requires students to find three numbers to open a family safe:

> "This is a fun place. The family gathered here on holidays to play such games as Monopoly, Trivial Pursuits, and Pictionary. Andy was usually the luckiest and would always win. Clue: The answer to the third number of the combination is the sum of the digits in Andy's phone number + the secret formula + November Snooze."

This clue, saved as a word processing document entitled "Family Room," requires the students to access a database, as well as investigate the other clues in "Family Heirs" for the secret formula and the meaning of November Snooze. Content information and reading for understanding can be reinforced by writing clues that refer to information presented in other clues. For example, the "Library" clue requires students to refer back to the "Magic Room" clue to obtain information about Houdini. Interdependent clues can be as complex or simple as the teacher sees suitable. Teachers can write clues that focus on specific skills and strategies, also.

In a *Desktop Adventure*, each clue is saved as its own independent document. To solve a *Desktop Adventure*, all of the documents pertaining to that adventure are opened and students access or "jump" to each document using the Window menu option. Each adventure should begin with an introduction that provides the students with the background and goal of the adventure, as well as the directions for completing the adventure. With a projection system, *Desktop Adventures* are ideal for whole-class, cooperative group instruction. Programming skills are not necessary, fonts can be enlarged for whole-class viewing, drawing tools can be used to enhance the presentations, database and spreadsheet options can be included, and a telecommunications component can be added. They can be custom designed by both teachers and students and integrated into a variety of different subject areas. *Desktop Adventures* add a new dimension to integrated software packages, encourage cooperative learning and communication among students, and allow teachers to customize problem-solving scenarios for his/her students.

Focus

Simple Multimedia Interactive Tools for Music Enthusiasts

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Key Words: music, MIDI, multimedia, keyboards

Two specific multimedia tools will be shown in this session. The first, *Music Mastery*™, is a Macintosh and *Windows*-based program for playing, learning, teaching, and composing music. Its many features appeal to people with a broad range of musical interests, from beginner to advanced. Some of its more important features include:

- Enter a piano score using MIDI input and playback through MIDI.
- Pitch Master, Rhythm Master, Melody Master, Rhythm Creator, and Melody Creator activities where *Music Mastery* helps you through hidden drills. For example in Pitch Master, you try to match the pitch of a hidden drill while *Music Mastery* provides the rhythm as you play in the notes.
- Access *QuickTime* to take advantage of the 128 General MIDI instruments using only your Macintosh to playback your compositions or drills!
- Create your own drills and lessons easily created through the Lesson Creator feature of the program.

The second program to be shown is *Clip Creator*®. This program is *HyperCard*-based. Its new features will be demonstrated:

- *Clip Chart*™ allows you to select a portion of an audio CD and mark points to divide the selection into a linear analysis showing the sections. Three upper sections can be added to the initial analysis. Comments to any section may be added that will appear as the section is played. "Hot" text can be added to general comments. Color and/or patterns can be used to make the form clearer. An analysis of the selection with useful commentary is the result.

- *QuickTime/*Graphic features allow you to import graphics into your linear analyses.
- Three different editor cards interact with store-bought audio CDs, LaserDiscs (CAV or CLV) or MIDI: CD Editor Card—This card lets you name the collection of excerpts that you create from ant audio CD, control the player as you would from a remote unit and create individual excerpts. Video Editor Card—This card will figure out what kind of LaserDisc (CLV or CAV) you are using and allows you to create excerpts. MIDI Editor Card—This card allows you to play in MIDI excerpts or load SMF's (Standard MIDI Files) and to save them in an excerpt list.
- Five different games can be created using the "Master Drills" feature. These drills are created using the excerpts made in the editor cards—Match Game, Recognition Drills, Multiple Choice, True or False, Concentration, Study List. When in the test mode, individual student scores can be recorded for teacher use.

Project

Collaboration with Teacher Education and Instructional Technology

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Key Words: **teacher training, multimedia, collaboration/integration**

Washington State is preparing to enact major education reform K-16. The performance based outcome model is mandated to be implemented state-wide by 2005. Western Washington University (WWU) is one of four regional institutions with teacher training programs. There is a major emphasis in the reform to collaborate with individuals involved in technology and integrate the use of technology across the curricula. Such collaboration and integration at WWU has been highly beneficial for the Secondary Education Program Area and the Instructional Technology Area.

The two areas looked at the various aspects involved in teacher training, examined the reform documents, the benchmarks and the mastery learning events which need be incorporated into preparing Washington State teachers for the next century. Secondary concentrated on preparing teachers in the scientific, professional and artistic strands of teacher education.

The first collaboration involved the production of a multimedia product which would effectively deliver a new course entitled *The Teacher As Actor.* Up until this point the content included in the new course was dealt with in one-week workshops and used 92 transparencies, eight movie clips, two television clips, and music selections. With the assistance of an internal grant, Secondary Education and Instructional Technology consolidated all the various media onto a single LaserDisc. The course was piloted fall quarter 1995 with tremendous success and reaction from the students. The class met in a state-of-the-art room with overhead projection units, three retractable screens, hook-up for a Quadra cart—all controlled from a touch pad wherever the instructor happened to be.

The second collaboration centered around the need to enhance the university supervisor's observation and critiquing of student interns. Previously, the observation form was a triplicated-carbon form measuring 11" X 14" and required each supervisor to respond, in writing, to five broad categories and sixty-five sub-categories, plus narrative comments. Instructional Technology assisted in writing a program which allowed a "like-form" to appear on a lap top. The "pack" given to the supervisors also contained a portable printer. The supervisor is now able to print out enough copies for the supervisory team and the student intern which is totally legible, can contain precise communications the student teacher made and the narratives are not limited by the amount of "white-space" allowed on the traditional form. Each observation can be transferred to a single disk for each intern, so a running dialogue is maintained and easily accessed if needed in preparing the final evaluation.

The third collaborative effort focused on how to reach students who do not make it to the orientation for secondary education. Each student receives important information and directions at the orientation, plus they meet the secondary faculty and are given various forms/procedures which assist them in going through the program on time and with fewer problems. However, those students who do not live in the immediate area cannot always make it to campus for one hour to be oriented. Publishing a web site page appeared to be the answer. Students can now call up the Secondary Education Program Area page and basically be oriented via the technology. The page contains photos of faculty and staff, their office hours, e-mail address/phone numbers, areas of expertise and hobbies. The numerous forms have been scanned onto the page with explanations (orally) providing additional information. Course offerings are given more narrative space than in the conventional catalog so that students have a better idea of what is expected of them in each class.

The academic year for secondary education courses is also offered so students can easily plan out their year. If changes need to be made to the schedule, it is a simple matter to do so on the page rather than in the printed schedule which is given out at the beginning of each quarter. Students may also leave questions for various faculty and staff which need to be answered regarding admission, retention and progress in the program. The overall benefit of the web site has been fewer questions concerning "housekeeping" items and a seemingly clearer understanding of the Secondary Education Program.

None of the above would have been possible without the collaboration/integration of Instructional Technology and Secondary Education. The Secondary faculty neither had the time nor the expertise to develop the complicated programming, much less the necessary equipment to achieve any of the technological improvements. By working together the "best of both worlds" was used and the end products were obtained with few headaches and anxiety attacks from faculty having little knowledge of the technological advancements "out there!"

Project

Staff Development with Hypermedia: Hands-On Image Processing

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Key Words: **image processing, staff development, hypermedia, science education**

The Hands-on Image Processing (HIP) for Educators package, funded by the Annenberg/CPB Math and Science Project, is a multimedia collection of resources and tutorials designed to introduce teachers to digital image processing and its use in science, math, and technology classrooms. The package contains a hypermedia tutorial on CD-ROM, a video showing classroom implementation and management, and a user's guide.

Image processing has become an increasingly popular use of technology in science and math classrooms. Pioneered by the Image Processing for Teaching project at the University of Arizona, teachers and students use digital image processing on classroom microcomputers to provide a powerful medium for exciting students about science, mathematics and technology. We have found that visual learners and others whose needs have not been met by traditional language- and symbol-based ways of introducing these subjects have been drawn into the study of science and math using image processing. The use of the scientific tool of image processing leads students and their teachers into exploration and discovery using original data sets, either created locally or gathered from the wealth of information available via the Internet. Examples include data from NASA space missions, images from weather satellites, electron microscope images, digitized video of athletic events and much, much more. Successful classroom implementation of any technology on a widespread basis requires high quality staff development. The emergence of image processing has led to a national demand in-service teacher education, and the non-profit Center for Image Processing in Education, based in Tucson, AZ, offers three- to five-day in-service workshops given by teachers for teachers, and sited in their home districts.

However, it is often difficult to organize extended staff development workshops and many teachers cannot access this on-site training. To meet the needs of this group, we have developed HIP for Educators. Designed by a team of teachers and scientists, this hands-on package introduces teachers to the concepts of image processing and to classroom management techniques for technology-based learning. Teachers working with the HIP for Educators package gain the skills and experience necessary to implement image processing in their classroom. The CD-ROM tutorial includes guided lessons, image processing software, activities, many, many images and supplementary materials. Teachers and students can work through the tutorial at their own pace or use it in a lab setting. It also serves as an extended resource as image processing becomes a part of the curriculum.

The HIP for Educators package also features a video with interviews with teachers and students who are using image processing. The video also includes a section on classroom management and curriculum development to provide examples of good practice.

Given that change cannot occur in a vacuum, HIP for Educators provides follow-up support to make implementation a reality. Both telephone and electronic access are available for teachers to have questions answered or to become part of the growing number of educators nationwide who are bringing the excitement of exploration and discovery through image processing into their classrooms.

In our presentation, we will demonstrate HIP for Educators, as well as a number of curriculum applications of image processing in science, math and technology, developed by teachers for teachers. Come and explore new curriculum for your technology.

Focus

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Key Words: **staff development, Logo, multi-cultural education, teacher training, LEGO**

The St. Paul Logo Project is different. For the past 14 years, Geraldine Kozberg, founder of the project, has held a series of administrative positions in program and staff development with the St. Paul Public Schools. None of these positions has been "Technology Coordinator." In St. Paul, Logo is not only something to do with a computer—it is one of a number of programs and strategies aimed at school change and improvement. Currently the project is part of "Who Are We?," a program of staff development designed to prepare teachers for work in a multi-cultural society.

Logo in the Classroom

St. Paul has avoided schools' tendencies, described by Seymour Papert in *The Children's Machine*, to confine computers to a special place with a specialist teaching "computer literacy."[1] In St. Paul, Logo is part of the life of classrooms, taught by regular classroom teachers. Even at the secondary level, Logo is used by mathematics, science, English, social studies, and art teachers.

First grade teacher Helen Kraft at Jackson School developed a science project on animals. It was not a "Logo project," but Logo played a part. Along with many other activities, children drew animals and wrote about them using Logo. In the process they also learned some geometry. Through Logo, many children began writing before they learned to read.

At Mann School, the school-wide curriculum for the 1989–1990 school year was the Middle Ages. The culminating activity was an "Expo" during which the gym and corridors were filled with exhibits of student work for parents and other visitors to see. Judy Ronnei's fifth-graders built a LEGO castle, complete with computer-controlled drawbridge and jousting knights. A computer was set up with a quiz about the Middle Ages. But it wasn't the students who were being subjected to this quiz. They wrote it in Logo for the visitors to test their knowledge.

St. Paul students created a LEGO Logo exhibit at the Minnesota Museum of Science. It included a "house of the future" in which furniture automatically moved out of the way when a vacuum cleaner approached. An "alarm bed" tilted up, sliding its occupant out a window and down onto the street below, ready for the day ahead.

Assessment

When it came to assessing the early results of working with Logo (1983 and 1984), University of Minnesota sociologist Pete Fire Dog found that about half the students using Logo showed academic improvement, according to their teachers. Improvement was seen among students of varying backgrounds. "Logo effects seem to be both wide ranging and substantial, and appear to be available to students from almost any type of learning, social, or motivational background."[2]

Collaboration

From its beginning in 1982, the St. Paul Logo Project has been a collaborative effort with corporate, university, and foundation support playing a major role. The St. Paul Companies provided financial aid. Engineers from the 3M Company tutored in classrooms. University partners included University of Minnesota, Macalester College, and Hamline University.

Outside consultants have played an important role. Seymour Papert and other members of the MIT Logo Group have taught and lectured in St. Paul. Logo Computer Systems provided software, materials, and professional development services. Since its founding in 1991, the Logo Foundation has worked closely with the Project.

The St. Paul Logo Project has been a mecca for educators from other districts, many of whom have attended the annual Logo Summer Institutes that have been the foundation of Logo teacher education.

These Summer Institutes are the focus of ongoing teacher education which also includes fall and spring follow-up workshops for each summer group, and after-school workshops arranged on an as-needed basis with the staffs of participating schools.

Summary

Over the past 14 years approximately 420 teachers from over half of St. Paul's 66 schools have been involved in the project. Currently there are 23 active Logo schools.

The Project has changed with the times, adopting new software and hardware. What has not changed is the commitment to Logo's constructionist philosophy, and to educational equity and school improvement.

Endnotes

[1] Papert, Seymour, The Children's Machine, Basic Books, New York, 1993.

[2] Fire Dog, Pete "Exciting Effects of Logo in an Urban Public School System" *Educational Leadership*, September 1985.

Focus
Hottest Music CD-ROM Titles

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Key Words: **music, CD-ROM, multimedia**

The latest music CD-ROMs will be demonstrated highlighting their major features. Emphasis will be placed on those CD-ROMs that are fun to work with, have colorful graphics, and are educational. As of this date, the following will be shown: *Making Music, The Musical World of Professor Piccolo, Rock, Rap n' Roll* (new education version), *Thinkin' Things 2, Beethoven's Fifth, Apple Pie Music, Musical Instruments,* and possibly more.

The intended audience is K–12 general music educators, media specialists, and college professors who are in the area of music education.

Most of the CD-ROMs are on both Macintosh and *Windows* platform. The hardware that is needed will also be explained. Below is a synopsis of some of the more popular choices. Some of the explanations are taken from promotional material, but, I feel, accurately reflect the nature of the CD-ROMs. We have included our discounted prices as of fall 1995, so they may change by the time you read this in June or may have been discontinued. Unfortunately that happens more often then we like. But hopefully more will be available by NECC '96.

The newest music CD-ROM is *Making Music.* It's a "composing space for children...using the same tools that composers use, without asking them to know musical notation. Kids can experiment, let their imaginations go wild, create a structure as they go and really make music." No reading is required. It is available for Mac or *Windows* (Hybrid version). $39.95.

Musical Instruments is an interactive journey into 200 instruments of the world. You can "hear and play 1,500 sound samples and view 500 high-quality photographs of musical instruments and ensembles." It is available for Mac or *Windows* and is also $39.95.

Rock, Rap n' Roll has been re-released by Silver Burdett Ginn in an educational version. You can choose from ten different musical styles of the world to create your own digitized composition. Styles include Africa, Big Band, Reggae, Rock, Blues, Latin, Rap, Soul, Jazz, and Pop. MIDI is not used. Everything is done from the computer keyboard. Available for Mac or *Windows* at $39.95.

One of our favorites is *Musical World of Professor Piccolo*, for Mac or *Windows*. This is a self-paced, interactive music theory course that makes learning fun and gives children "a firm foundation for understanding the many elements of music." Topics covered include theory, notation, music styles, instrumentation and more. $39.95.

Apple Pie Music is about music of American History that includes colonial, expansion, and industrial events. The history of American music is also portrayed through popular, religious and folk music. It includes over 400 pieces that represent Americans' music for almost 350 years. Hybrid version is available. $49.95.

Thinkin' Things 2 has great color graphics. It contains critical thinking activities for Grades 1–6, so it covers other areas besides music. There are five activities to help students advance their musical and artistic creativity, memory, listening, and problem-solving skills. It is available on a Hybrid CD-ROM. $49.95

Beethoven's Fifth explores this symphony in many ways. You learn about the orchestra, see and hear each instrument played. Videos demonstrate each instrument being played. Included are three games to test your musical expertise: Play the Tune, Match the Tune and Tune on Trivia. $29.95 in a Hybrid version.

Focus

MicroWorlds 2.0: The "Turned on" Logo

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Key Words: **Logo, MicroWorlds, multimedia, interdisciplinary, problem solving**

Logo in one shape or another has been a consistent representative in educational technology for over fifteen years. As technology has advanced new versions of Logo have developed along with them. Although these new versions have included features taking advantage of current computer technology they have never lost sight of the original goal of providing an educational tool for students to explore environments including math, science and language.

MicroWorlds 2.0 is one of the most recent contributions to the Logo world. While still very much Logo, it incorporates the power of the Macintosh so that students' explorations and projects can include video components through *QuickTime* movies. LaserDisc players can be controlled with video clips and sound clips added as part of a student's project.

Intermediate age students have no difficulty creating graphics and text using the available tool features. With only minimal additional direction students are able to set objects in motion on the screen and to create multiple screens with buttons linking the pages. Whether telling a story or reporting on curriculum based information such as the rain forest or constellations, students have maintained a high level of interest. Students with beginning ability can feel successful. Students with very advanced skills can produce multimedia projects with ever increasing sophistication.

In St. Paul, Minnesota, teachers trained in the use of Logo based products have found that students become involved in academic projects often finding connections across subject areas. In addition the feature that teachers mentioned often is Logo's strong tendency to involve students in many levels of problem solving.

The many features of this powerful classroom application that includes traditional turtle graphics and programming, drawing, video, sound, and text tools will be introduced. In addition intermediate age student developed projects that highlight the use of buttons to control screen events, sound bits, and video will be demonstrated.

Focus

The Virtual School of Winona: An Online Community

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Key Words: **Internet, Web, HTML, online, school, virtual**

The Virtual School of Winona™ will connect over 700 Winona families from their homes with their schools through a computer and dial-up access to the Internet. The Virtual School of Winona is available on the Internet's World Wide Web.

Information available to families through The Virtual School of Winona (TVSW) includes: school calendars, e-mail among students, faculty and staff, weekly homework assignments, test calendars, online study groups, online study aids, lunch menus, school memos, school newspapers, examples of student projects, and more.

In collaboration with The Minnesota Preparatory Schools and Vanguard Technology Group, TVSW will equip each participating school with computer technology, and educational resources equal to that of Cotter High School, Winona, MN, winner of the Golden Apple Award from Apple Computer, Inc. for its excellence in the use of technology. In addition, TVSW has partnered with US West Advanced Technologies and Carnegie-Mellon University to research the impact of this home-school connection on the lives and culture of students, parents, and school staff members.

During the '95–'96 academic year, TVSW is open to participation to families at two Winona secondary schools. During the '96–'97 academic year, TVSW is open to participation from four other Winona schools. In association with its partners, TVSW will extend this program through Internet site development by creating local versions of The Virtual School in cooperation with interested K–12 schools and districts across the nation.

The Virtual School of Winona is an educational collaboration among the Hiawatha Education Foundation, The Minnesota Preparatory Schools, and Vanguard Technology Group.

Society

Computer Science Education in the People's Republic of China (ACM SIGCSE)

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Key Words: **computer science, computer education, women in science, computer education in China, programming, teacher education**

A 32-member Computer Education Delegation organized by the Citizen Ambassador Program of People to People International visited the People's Republic of China from October 4–19, 1995. The delegation visited universities as well as K–12 schools in Beijing, Hangzhou, and Shanghai. In each city, the panelists spent time talking with computer science educators and researchers, touring departments and facilities, and observing research projects in progress.

The Computer Education Delegation had the following objectives: (1) to allow professional computer and technology educators from diverse parts of the world to share ideas, compare methods and problems, and develop worldwide links for professional support and development; and (2) to visit school sites where technology is taught and used, and interact with teachers and students in their own environment.

This society session shares the information gathered from the meetings, seminars, and informal discussions with counterparts in China. The panelists will cover:

- Overview of the education system in China
- Role of the government in establishing computer and technology education policies
- Computer science education in primary, secondary, and post-secondary classrooms
- How the first course in computer literacy is taught at a university in China

- Opportunities and incentives for women who choose to enter technical fields
- Availability of Internet access
- Education and training requirements for computer science and technology specialists

Each of the topics will be viewed from the framework of the remarkable recent economic growth and development in China.

Position Statement from the Panelists:

Technology is rapidly advancing in China. The more advanced universities offer programs and curricula that explore the capabilities of emerging technologies and provide comprehensive offerings in the range of computer science core areas. Through creative funding, often with government and corporate assistance, the hardware and software is current, but not in great quantity. Particular emphasis was evident on the development of graphical applications and use of multimedia. At the same time, technology is creeping into the elementary and secondary schools, with a number of university programs designed to train computer science and technology specialty teachers for schools. There are still considerable economic barriers to providing access to technology and networks to the whole country or even to all schools. What was most impressive, however, was the spirit of the Chinese people. In a land filled with traditions and contradictions, there is a sense that the people will persist and live in harmony with technology as it becomes more of a part of their environment. One can wonder how dramatic the changes might be in the next few years to come.

Focus

City of Nevada Telecommunity Project

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Key Words: **technology in schools, teacher inservice, telecomputing infrastructure, telecommunity, rural community, economic development**

The Nevada Telecommunity Project is an experiment in how technology can broaden the horizons and extend the prospects of rural communities. The Nevada Area Economic

Development Commission (NAEDC) has been conducting a community education and needs assessment that will bring telecommunications and global electronic linkage to the city of Nevada, Missouri. This feasibility study has involved local government, businesses, health providers, lawyers, residential developers, and educators as well as faculty and deans from the University of Missouri at Kansas City (UMKC) and funding from the Missouri Department of Economic Development (MDED). The essential foundation of this project, then, is the construction of an advanced telecommunications and telecomputing infrastructure in the city of Nevada.

This focus session discusses the process of assessing needs, planning development and implementing the infrastructure necessary to meet the education goals of the Nevada Telecommunity Project. The target areas of the Education Subcommittee of the Nevada Telecommunity Project are:

1. Technology Infrastructure Planning
2. Inservice Training and Planning
3. Curriculum Assessment and Planning Exercises

The technology infrastructure planning involves the general design of educational computing laboratories and the detailed, but still generalizable, design of the LAN, MAN and telecommunications systems in Nevada necessary to interconnect these laboratories. This subgroup will:

1. produce design guidelines and models for educational computing and communications laboratories;
2. provide design guidelines and models for interconnecting these laboratories within a school building, between buildings and to an Internet gateway; and
3. provide detailed options in each of these cases and facilitate their acquisition wherever possible.

The inservice training and planning involved a needs assessment and a capability assessment which was used to design the training for teachers, re-training for the present work force, and the curriculum for the future work force. Workshops include:

1. On-site/hands-on workshop conducted by local personnel or UMKC personnel;
2. Independent use of multimedia modules;
3. Interactive, distance learning where the teacher lectures at possibly UMKC, learners receive the lecture through Ednet, and teacher and students interact through e-mail or video conferencing.

Various delivery media are being designed so as to reach the range of learners from grade one to the older adult. Methods of delivery such as closed-laboratories, process testing, multimedia, self-paced lectures, and interactive, distance learning are used to meet the various learning styles of learners.

The curriculum assessment and planning exercises involve the formation of "academic alliances" within the community. These "academic alliances" are loosely, organized groups of educators from all levels with a common interest, focused on a common need. For example, mathematics teachers from Cottey College, R-V senior high, middle school and elementary schools meet once a month and share information about supporting the teaching of mathematics with technology. Mathematics teachers from the feeder schools of the Vocational Technical Regional Center have also been included.

The final outcome of the project in its entirety is to produce a "template" that other rural areas can use to become involved in the global telecommunications network. Alan Kenyon, Director of NAEDC, notes, "The decision and commitment to link Nevada with a global telecommunications network is as important to our economic growth in the future as the building of paved highways and the railroad were to Nevada over 100 years ago."

The panelists will present an overview of the project and describe in detail the following activities of the first year of the project:

1. How to host a successful technology expo for your district and surrounding districts.
2. Designing and conducting workshops for various levels of technology users.
3. Reorganization of a school technology committee to involve all grade levels, administrators, parents, and business leaders.
4. Developing a technology plan that would make the district an advanced technological learning environment of the future.
5. Examination of networking options.
6. Pros and cons of each method in order to bring Internet to your school building/district.

Project

Iguanas to Igloos: Practical K–12 Ideas for CD-ROM

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Key Words: **technology integration, project-based learning, thematic units, multimedia, CD-ROM, LaserDisc, Internet**

I've got computers and CDs, now what do I do with them? Some CDs have thousands of screens of information. With only one computer in my classroom what's the most realistic way of getting all the children involved? Where does technology fit into a traditional lesson plan?

This session addresses these questions. Looking for fun projects that integrate CD-ROMs into your classroom? From iguanas to igloos, we explore practical, interdisciplinary applications of CD-ROM in the K–12 environment. Specifically, the session examines different categories for CD-ROMs and how you can use each in your classroom. Practical ideas for integrating CD-ROM into interdisciplinary multimedia thematic units are also highlighted. Although most of the session focuses on CD-ROM applications, many activities and suggestions incorporate other technologies such as LaserDiscs, videos, books, and Internet resources. The first part of the session discusses the different types of CD-ROMs used in schools including informational, instructional and creativity resources. The second section discusses the development of lessons that incorporate technology. Finally, the session concludes with popular themes, topics, and technology resources to get you started developing thematic activities for your classroom.

Informational Resources

Our libraries have traditionally provided a wealth of information resources in formats including books, maps, and videos. Today many of these resources are available through the computer. Informational resources provide text, sounds, and/or visuals related to a particular topic or area. You'll find the same kinds of resources available in print formats including reference resources, nonfiction materials, and fictional works.

Reference

You're probably most familiar with the reference resources. Electronic encyclopedias, dictionaries, almanacs, and atlases would fall into this category. References often provide general information about a topic.

Nonfiction. Like nonfiction books, nonfiction educational software provide in-depth information on a particular topic. Informational resources often provide main menus, indexes, and other tools to help users locate materials of interest. In addition to information, some of these resources also provide games to help students explore the information.

Fiction

Everyone loves a good book. Many print materials have been adapted for the computer format. In some cases, sound, animation, and information resources have been added to the original text and graphics. For example after reading a page aloud, the computer may encourage the child to explore the animation features of the document. Fictional materials include linear, "read-aloud" books, interactive books, and novels. Some of these resources provide "hypertext." In other words, users can click on words for definitions, pronunciation guidance, pictures, or additional information. Fictional materials aren't just for children. There are an increasing number of fictional works that provide a nonlinear fictional world for students to "explore" rather than using a "page-turning" book metaphor. They include features such as voices, video, maps, and character analysis.

Instructional Resources

When computers first became popular educational tools many of the instructional resources were simple drill programs developed to help students practice skills such as math or spelling. Instructional software has evolved to include sophisticated simulations and problem-solving software.

Tutorials

Tutorials provide step-by-step instruction for teaching new concepts. They are designed to provide new information along with examples and nonexamples of concepts. In addition, practice and feedback is often incorporated into the program. Tutorials work well when introducing new concepts, reviewing difficult ideas, or providing enrichment.

Some tutorials are linear. In other words, they provide the same information and examples to all learners in a predetermined order. Sometimes called "electronic pageturners" they don't address the needs of individual students. On the other hand, branching or hypertext software provides alternative paths through the program. Each student receives the instruction he or she needs based on responses to specific questions or problems.

Practice Programs

Drill and practice software was the first widespread application of computers in the classroom. Other than fancier "bells and whistles," many of the approaches have changed very little since the 1960s. This type of software is intended to reinforce concepts and allow opportunities for students to practice. Although some software provides instruction in addition to practice, it is not intended to replace traditional instruction. Instead, it is intended to support classroom instruction.

Simulations

Simulations help students apply their skills to "real life" situations by providing an environment to manipulate variables, examine relationships, and make decisions. This software is often used after initial instruction as part of application, review, or remediation. Physical simulations involve students in using objects or machines such as microscopes or airplanes. Procedural simulations involve a series of actions or steps such as medical diagnosis or frog dissection. Situational simulations involve critical incidents within particular settings such as interactions with customers. Process simulations involve decisionmaking skills related to topics like economics, genetics, or geology. Students choose among alternative paths.

Problem Solving

Problem-solving software is intended to assist students in developing skills related to making effective decisions. Although similar to simulation, more emphasis is placed on reasoning, logic, and critical thinking. This software generally involves a set of procedures to accomplish some type of goal. Students may identify a problem, plan an approach, gather information, develop strategies, test hypotheses, and develop plans of action during the program.

Creativity Resources

Students can use creativity resources to develop exciting classroom projects that involve writing, drawing, recording sounds, and incorporating video. Think of these as the tools of technology. Just as students use paper, pencils, markers, calculators, rulers, and other traditional classroom tools, they can use software to assist them with designing, developing, and delivering effective communications. Writing Tools. Professional productivity tools can be used for writing, organizing, and calculating software. Although some students use software designed for adults, there are many tools designed specifically for children and young adults that provide templates, clip art, activities, and evaluation ideas. With these creativity tools, students can easily view writing as a process rather than a chore. Prewriting activities such as brainstorming, listing, questioning, freewriting, clustering, webbing, and outlining are easy on the computer. With the computer hooked to a large monitor, the teacher can lead students through the writing process as a large group. Many clip art resources can enhance student projects. Animals, holidays, sports, education, business, comics, and food are just a few of the clip art CD available. A new software trend is toward creativity tools that are associated with particular themes such as neighborhoods, oceans, rainforests, and castles. Students can incorporate objects related to the theme.

Data and Calculation Tools

Electronic databases and spreadsheets are popular computer productivity tools for adults. They are also popular with K–12 classrooms. Students need skills in locating, evaluating, analyzing, classifying, comparing, calculating, and drawing conclusions based on a set of information. First graders classify animals, fourth graders compare and contrast information about states, and high school government students analyze political systems. The computer is a logical tool to help store, calculate, retrieve, and visualize information. Middle schoolers conduct what-ifs on business ventures and senior math students graph trigonometry problems.

Multimedia Tools

Multimedia has emerged as an effective way for students to develop projects that incorporate text, graphics, sound, and video. The packages provide tools for students to paint pictures as well as add text, animation, video, sound effects, and music to create an exciting multimedia project. In addition to the regular multimedia features, some packages provides tools for creating interface features such as menus and popup text and pictures.

Instructional Strategies for Technology Integration

Where does technology fit into your lesson? Technology integration is much more than just "saying" you're going to use a computer. You've found a neat software package, now how, when, and why are you going to use the software? Your lesson has many components. Where would the technology fit best? How is going to be used; to introduce the topic, explore information, provide practice, or end the lesson with a bang?

What's the Secret? 3M Learning Software

Let's explore the software package *What's the Secret* by 3M Learning Software. It's based on the public television program *Newton's Apple*. The CD-ROM contains information, questions and answers, activities, videos, lab experiments, and all kinds of projects. There are endless possibilities. You can't just tell student to "use it." You need to focus on specific activities that will address particular aspects of your lesson. For example, as students are studying insects, you might incorporate elements of the "Why do bees make honey" section of the CD. Students may select or be assigned specific activities while using the CD. They could complete the beekeeper simulation, use information to create their own *HyperStudio* stack on bees, or make a model of a bee. Again it depends on your lesson objective. Just because making a bee sounds fun doesn't mean you should do it. Is it appropriate for the grade level? Is it a good use of time? What will students learn? How long will the activity take? Will students work individually or in small groups. With every activity consider both overall technology management as well as placement of the technology within the teaching/learning sequence. Springboard Activities. Technology makes a great motivator. Consider using technology at the beginning of your lesson to gain student attention. Use technology as a focal point for your lesson. For example, *Wyatt Earp's Old West* is not the most in-depth resource on the old west, but it's a great motivator. Let students explore the old west town and use the resource to select the types of "Old West" career they'd like to study in-depth. In other words, the CD-ROM becomes the basis for a class boom town.

Another important element of your springboard activity is informing the learner of the objective. Think about what technology might be used to demonstrate the knowledge or skill you're teaching. Let's say that your physical education students are doing strength training. Use the *A.D.A.M.* CD-ROM to show what will happen to their bodies as they train. Early in your lesson, you may find that students need help recalling prior knowledge. For example, *The History of the World CD-ROM* might review historical events leading to the current lesson. Some students may need more review than others. For example you might use the *Reader Rabbit* software series to review basic reading skills before introducing new concepts.

Information Exploration

Technology may be an important element in the information exploration phase of your instruction. Books, videos, maps, CD-ROM, and LaserDiscs can all serve as effective resources to access information. Consider the most effective format for presentation of information. Video and LaserDisc resources work well in large group settings, while books and CD-ROM are often better for small group or individual exploration.

Consider the purpose of the technology. Is it meant to inform or instruct? Without guidance, students may lose focus in information exploration activities. With thousands of screens of information on a CD-ROM, students need research questions and search guidelines to direct their activities. For example, let's say you're studying inventions and inventors. The CD-ROM *How Things Work* is a great resource for exploring concepts related to this topic. It would take hours for students examine all the materials. You need to direct student attention to the section of the CD that contains the information needed to understand the concept. For instance, you might provide a set of instructions that guides the learner through the menus to the section that deals with a particular invention or the timeline of events. Once they access the information, they need experiences that will help them relate the content to knowledge they already possess, apply the information to new situations, and draw some conclusions about the use and importance of knowing the concept.

Student Involvement

Student involvement is critical to learning. Students can use technology as an effective interactive tool, if the teacher designs activities that require students to think and do. Problems can be presented in a handout or through a video clip. Use virtual field trips and simulations to involve students with the subject matter. For example, in *Capital Hill* by Mindscape, learners become a member of Congress and learn about the daily activities of a representative. As you preview software such as Capital Hill be thinking about how long it will take students to use the program, whether it will be part of an individual or small group activity, how much information students will need before using the software, and whether this is the right type of activity to reach your outcome. Computer software can provide individualized practice and feedback. Creativity tools allow students to synthesize, calculate, and communicate ideas. Students can produce videos that demonstrate their understanding of a procedure or experiment. None of this will happen without careful planning. You need to know the purpose of the activity and how it relates to your desired outcome, otherwise the involvement activity is "busy work."

Assessment is an important element of student involvement. Students need to be aware of what will be graded and how it will be graded. Will you use checklists, rubrics, traditional tests, computerized scoring, or other assessment tools? The tools should match the objectives and activities. Technology can be integrated into the assessment phase of your lesson. For example, let's say students have been learning about the butterfly. You might use the images from a CD-ROM as part of a test. Show a still picture and ask students what the butterfly is extracting from the flower.

What are your expectations related to the content and the technology? Give students opportunities to share their findings and projects with others. It may be sharing with younger children or making an oral report to the class. The communication may go beyond the school in the form of a letter to the editor or a community cleanup project.

Closure/Transition

Effective culminating activities should leave a positive impression on students. Closure/Transition activities include simulations that require students to bring information together and apply it to new situations, bulletin boards that allow students to display their work, and handouts that review new skills and relate these to new situations.

Let's say you've just completed a physics unit that focused on force. You've provided lots of examples, but the most fun example was how a roller coaster works. Let students search CD-ROMs or the Internet for information about roller coasters and their design. Ask them to apply what they know to the design of a roller coaster. You could do the same thing in a math class where you've been studying geometric figures. Have student create a miniature golf course.

Interdisciplinary Approaches to Technology Integration

The final section of this session focuses on ideas that can be used to create your own interdisciplinary materials. Each project contains CD-ROM materials, other resources, key words, and a list of ideas. The proceedings do not contain the space to provide information on each unit. Instead an overview is provided of a few of the units discussed in the session.

The Global Community

Students enjoy learning about other cultures. Use *Material World* as a focal point for your activities to help them explore life in another country. Use Internet pen pals to compare the families they read about with real students around the world. Use the *Amnesty Interactive* CD to provide information about human rights concerns around the world. Are kids in other parts of the world concerned about human rights? Compare the "quality of life" and economics of different countries using the Crunchers software.

Exploration to Discovery

Connect the past, present, and future by investigating famous explorers from the past and present. Compare and contrast the missions, roles, and purposes of explorers through history. Examine how and why different cultures "reached out" to discovery and settle new lands.

Imagine, Investigate, Invent

How was the television invented? What about all the other machines we use everyday? The books we read, the bikes we ride, and the food we eat were all created by someone, sometime. Who, what, when, where, and why? Start with *Leonardo the Inventor* and explore the life of one of our most famous inventors.

Save Our Environment

Use technology to explore issues related to our environment starting with Apple's *Earth Explorer*. Use *HyperStudio* to create debates regarding environmental issues.

Science in the Real World

Bring science alive by exploring everyday questions. Use *What's My Secret* as the focal point for your activities. Hold a "real world" science fair. Share results of science experiments with other schools through the Internet. Create your own *What's My Secret* multimedia stack using *HyperStudio*. Create short stories that incorporate "science in the real world" ideas from *What's My Secret*.

Wellness

Explore all aspects of wellness including health, nutrition, exercise, and physical conditioning. Are you doing everything you can to stay "well"? Use CD technology to access information about wellness, as well as create products that will share the importance of wellness with others.

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Additional information and project ideas can be found in Lamb, Annette (1996). Building Treehouses for Learning: Technology in Today's Classroom, Evansville, IN: Vision to Action and Lamb, Annette, Smith, Nancy, & Johnson, Larry (1996). Surfin' the Internet: Practical Ideas from A to Z, Evansville, IN: Vision to Action.

Focus

Let's Go Fly a Kite: Technology in your Classroom

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Whether you like the traditional kite or a stunt kite, there's a kite and a technology for you. Come "fly a kite" as we explore the possibilities for students and teachers in today's classroom. Integrate technology into your classroom by combining the best of what technology has to offer. From CD-ROM and LaserDiscs to Internet there are endless informational and instructional resources for all ages. Help learning come alive for your students through effective, well-managed technology integration activities that work! Let's go fly a kite! Your mission: create exciting learning environments for children. Your tools: multimedia resources (i.e. CD-ROM, LaserDiscs, digitizing tools, Internet). Need ideas? This session provides practical examples of integrating multimedia technology into your classroom through exciting interdisciplinary multimedia thematic units. The session focuses on popular themes and how they can bring learning to life for children. Multimedia thematic units are an interdisciplinary approach to learning that combines context-based text, aural, and visual elements into an active learning environment. Multimedia resources (i.e. CD-ROM, LaserDiscs, digitizing tools) are added to traditional library/media information resources to create exciting, interactive learning environments. Thematic units can be designed that support skills across curriculum areas, as well as develop important information skills. These thematic units stimulate student curiosity by providing an in-depth look at a particular topic and relate it to real-world issues and concerns. Library/media specialists, technology coordinators and classroom teachers can take an active role in selecting and/or developing thematic units.

Selecting Technology Resources

Design a classroom environment where all technologies live in harmony. Books, models, kits, globes, realia, videos, films, maps, CD-ROM, LaserDiscs, digitizing tools, and Internet are only a few of the many resources that can be integrated into classroom activities. As you examine resources consider how each might be used in the teaching/learning process. Will the resource be used for information, instruction, communication, or motivation? Also ask the question: why bother? Technology itself won't make a difference in your classroom. It's the innovative approach to teaching and learning that will make technology worth the time and effort. Consider the attributes of each resource. Do you need a visual or auditory approach? Is motion or color important in your lesson? Are authentic problems or hands-on experiences essential? How much time do you have? Select those materials that will be the most effective, efficient, or appealing for the particular instructional need. Also consider the ease of use of the materials. Is it easy to learn and use? Is it easy to access information or create projects with the resource? Are there ways you could repurpose materials for different content areas, alternative instructional approaches, or different grade levels? Think about the unique qualities of the resource. For example, Internet can provide experiences that would be difficult to duplicate with other resources. Virtual field trips, timely materials, expanded resources, unlimited expertise, global communications, authentic information, varied information types and channels are just a few reasons why Internet is an important resource for classrooms. Before you decide to purchase new resources, examine the hardware and software you already have available. Use what you have and buy what you need. In other words, make use of everything in your building. If you have an old black and white LCD, use it for teaching the writing process. You don't need color if you're just dealing with text on the screen. If you have a black and white scanner, use paint software to color pictures you scan.

Before you give up on your old computers consider upgrades and extensions. Sometimes people purchase new computers when they really need to be investing in multimedia peripherals that will expand technology-based activities. You'll be amazed what a single scanner, video digitizing card, digital camera, microphone, CD-ROM player, "zip" drive, or color printer can add to your classroom. You can't choose between these resources, they're all important in building a multimedia classroom.

Building Interdisciplinary Thematic Units

Many teachers like to use themes in their instructional units. Themes focus on a single topic that is of interest to students. They provide a core for group activities by building on the natural interests of students. Writing, speaking, listening, reading, calculating, and content-related concepts can all be taught within the context of a theme. Themes can provide relevance for students by drawing together concepts under a single umbrella. In addition, themes can attract and maintain student interest over a long period of time and can provide continuity for a series of activities.

A theme can be an effective way to motivate students during a unit. Use the theme as a "focal point" for activities. Select a popular topic from the social studies or science area that has "interdisciplinary" possibilities. The environment, travel, social and health issues, and historical events are a good place to start. Another approach is to begin with a popular video, LaserDisc, CD, television show, or book that could be shared across ability levels. A single CD-ROM or read-aloud book can provide a shared experience. Regardless of background, prior learning, or reading level, all of the students can share in the theme through a single experience. This can serve as the springboard or centerpiece for the entire unit. Consider promotional ideas that will keep the theme fresh and exciting. The length of the unit will depend on the number of outcomes as well as the number of activities you identify. The kites theme is great for late spring as a year-end project for middle school students across content areas. The project began with students exploring kites in the electronic encyclopedia. Some students made connections with history and Ben Franklin. Others were interested in the fact that a kite is also a bird name. Many students enjoyed learning about where in the world kites are found. This exploration lead to specific activities related to course objectives. The science classes learned about how objects fly including kites and planes using *How Things Work* by DK Multimedia. The history and art classes connected the flight idea with Leonardo DaVinci and the *Leonardo* CD-ROM. The art class focused on the development of kites and used the Internet to identify kites sites. They even downloaded the rules for kite contests and modified them for use in a schoolwide kite flying contest.

Students used technology throughout the project to develop simple and complex projects. They used *HyperStudio* to create diagrams and to create a trivia stack on historical facts about kites. The computer applications classes used the kite theme as part of a culminating activity with *ClarisWorks*. Students developed a Kite Shop. They used the features of *ClarisWorks* to create various items for their shop including a store inventory spreadsheet and an advertising sign. They used math skills in designing their kites for the art class and created poems for their English class.

The session provides additional interdisciplinary thematic project ideas.

Managing Technology in the K–12 Classroom

Technology integration requires careful planning. Without structure, technology activities can lead to chaos. Students should know the expected outcomes of the lessons. They also need to know the purpose, schedule, procedure, and expected end products.

Purpose

Like any lesson, it's critical that you and your students know that purpose of the lesson. The purpose should relate to the concepts in a particular content area, not technology. We often talk about "going to the computer lab" or "doing LaserDisc today." Instead we should focus on the purpose of the activity such as writing a persuasive letter or describing the process of photosynthesis. So don't focus on "multimedia." Instead ask yourself, what are students going to do with the technology? Will they use multimedia tools to locate information or to communicate their ideas? Consider where in the lesson technology will be used and why it's important to that element of the lesson.

Materials and Supplies

It's essential that you carefully organize the resources needed for lessons involving technology. There's no way you can memorize everything you need for every lesson. A resource list at the beginning of your lesson plan will remind you of all the things you'll need. Without this list, you'll be scrambling for last minute resources. Consider the following areas: hardware (computer, printer, CD-ROM, scanner, camera), hardware supplies (batteries, bulbs, paper, cartridges), software (informational, instructional, applications, utilities), resource materials (books, pictures, clip art), storage (disks, folders on the hard drive, sample projects), and traditional supplies (folders, paper, pencils, markers).

Space

Hopefully you have technology resources available throughout your school. You may have a technology lab, multimedia area in the library, a faculty development area, an equipment check-out system, plus computers in your classroom. Regardless of the setting, you need to carefully design the area. Educators often spend thousands of dollars on technology and forget basics such as tables and chairs. The furnishings should match the characteristics of your learners. Younger children need smaller tables and chairs. Students should not have to reach up to get to the keyboard or look up to see the monitor. Arms should be at a right angle when using a keyboard and students should look across or down at the monitor. Remember space for the mouse. It's also important to provide space around the keyboard for students to refer to notes or books. Consider the following areas: location (lab, classroom, office, lounge, hall, library/media center), arrangements (rows, clusters, U-shape), furnishings (tables, chairs, workspace: height, durability), power (access, cabling, surge protection), air quality (cooling, heating, humidity, sunlight, drafts) and security (portable/permanent, locking to furnishing, locking doors, windows).

Grouping

Will the technology be used by individuals, pairs, small groups, or large groups? The format you select will depend on the type of learning required and the technology available. If students need lots of practice and feedback, individualized instruction may be the best choice. The computer can diagnosis the student's needs, prescribe practice, and provide corrective feedback. In some cases, pairs work better than individuals or small groups. The pairs could be like or unlike ability levels depending on the need. For example, you might use peer tutoring as a way for students to review. Pairs also work well when using technology for the first time. If one student gets "stuck" the other person can often help. Three students make a good computer team. With three students, one can be in charge of the computer, one has control over the mouse, and the third can play the role of director. With more students, it's difficult for everyone to read off the screen.

The key to effective small group use of technology is the assignment. If students will be having a small group discussion after watching segments from a LaserDisc, they'll need guidelines for their interaction. Groups may be asked to create a traditional project (i.e., poster, comic, creative writing, skit) based on the information found in a technology such as an informational CD-ROM. In this case, they'll need project guidelines and criteria to follow. Finally, small groups might use creativity tools to create a project using technology. They'll need skills in using the technology as well as sample projects to explore. It's important to discuss the role that each student will play in the small group. Who will "work" the keyboard? Who will make decisions about actions? Who will run the remote control for the VCR? You or your students may assign roles such as keyboardist, mouser, and selector. Or, you may ask the team to reach consensus on decisions.

To develop small group activities, you need to know your class well. What students work well together? Who will need extra help? Do you want students to work on their strengths or weaknesses? Will you assign specific jobs for each group member or let students self-select roles?

Roles

What's the role of the teacher? Will you be the "sage on the stage" or the "guide on the side"? In other words, will you be leading a large group discussion focusing on images from a LaserDisc or letting students explore the content in small groups? What's the role of the student? Will the student be passively observing the videotape or actively involved in answering questions or developing hypotheses? Finally, what's the role of the technology? Will the technology be the tutor or instructor providing information, practice, and feedback? Maybe the technology will be used as a tool by the student to create a poster, video, or graphic.

The roles you identify for the teacher, student, and technology will impact learning. Be learner-centered. Whenever possible, let students direct, lead, create, and activate. Effective teachers are managers, coordinators, and guides. Use the technology as a resource. Sometimes it serves as a great tutor providing individualized attention and feedback, while at other times it's better used as a tool for thinking, writing, or creating.

Schedule

Do the technology resources need to be "reserved?" For example, a computer lab might need to be reserved ahead of time. How long will each individual or small group take to complete the activity? Consider the length of the slowest and fastest student. Will they do their activity at one time or in small segments? What will students be doing when they aren't working on the technology activity? How will students move between activities?

It's a good idea to plan for twice as much time as you'll need. You can always expand a project, but it's difficult to find extra time if you're short. In addition, remember that students need time to explore and reflect. Exploration time isn't goof-off time. It's a chance to browse and examine alternatives. In the same way, students need time off to reflect on their exploration and think about the progress of their project. Teachers often get so task oriented that students have few opportunities to exercise independent thought. Will you post the time, use a timer, or ask students to regulate their own time? Most students can manage their own time on the computer. If they forget about the time, the next student in line will definitely help them remember. If you run into trouble with controversy over time, consider Velcro-ing a digital kitchen timer to the top of the monitor. Careful scheduling is critical. For example, let's say that it takes fifty minutes to use a social studies simulation program. With twenty-five students, you're talking about nearly fifty hours! If small groups of five could work together on the simulation, it would only take about five hours to complete the activity. Or if you have limited time, consider a large group activity.

Time should not be your only criteria, think about the objective of the lesson. Will students reach your expected outcome in a large group versus small group learning environment? If it's a culminating activity, a large group might work well. However if the software is intended to provide individualized practice, it might not have the necessary impact in a group situation.

Planning your rotation cycle can be tricky. Although it's easiest to randomly assign individuals or groups, careful planning will results in more effective use of class time. For example, let's say that students will be writing reports using the word processor. They can't begin writing until they've selected information and planned for their report. Your first group "rotating" throughout the word processing computer can't start until they've completed the information selection and processing phase. Also consider that not all members of a small group need to be at the computer at once. One member of the group may be typing while another group member is selecting pictures to scan. This can be confusing unless group members have specific roles and responsibilities.

Guidelines

Students need guidelines for the use of technology. Consistency can prevent chaos and encourages quality time on task. Start by asking students to assist you in developing a standard set of procedures for using technology. Regardless of whether you have two or twenty computers, you need some rules. These guidelines may include statements about appropriate and inappropriate use of technology, management of disks and the desktop, small group interaction, and other standard operating procedures. You may also want to discuss consequences of inappropriate behavior. It's a good idea to place these guidelines in the a student manual. Like any classroom, you may need to develop strategies to deal with recurring problems. Determine whether the problem can be eliminated by a change in the placement of technology or assignment. For example, if you place a classroom computer near a high traffic area, you're asking for problems with "walk by" interactions. It's helpful to ask students to write down the problem and discuss possible solutions. What's the problem? What's causing the problem? How can the problem be solved? If the problem involves constantly misplacing the timer, "velcroing" the timer to the top of the computer might be a single solution.

Technology Skills

As you develop activities that incorporate technology, consider the skills students will need to use the technology and the classroom procedures that will be followed in using the resources. Do students have the information skills they'll need to search and access information using the technology? Do students have the basic technical skills such as using a CD-ROM, keyboarding, and/or saving? You'll want to provide directions in using the software and for guiding the project. For example, you might start with a large group demonstration showing how the technology works. Provide a demonstration of the variety of resources they might be using. When exploring the Web or using CD-ROM information resources, show students examples of successful and unsuccessful searches and search strategies.

If you have a computer lab, you might be able to give each child a chance to do some initial technology exploration. However with a lab full of students, you're likely to have all kinds of questions. Demonstrate one step at a time and ask students to follow along. Use the "ask three before me" rule for peer learning. In other words, rather than students coming to you for help, suggest that they ask three classmates the question before asking you. This will provide you more freedom to address the more difficult problems.

If you don't have access to a lab of computers, use the "each one teach one" approach. In other words, select three children from your class and teach them the application. Then, ask those three students to teach three others. Now these six peer tutors can work with six more and before long the entire class knows the application.

Handouts are an important part of effective technology projects. You might provide step-by-step instructions for using software, criteria for the project, materials available, and sample projects. There are many ways to provide basic technology instruction to students. Step-by-step instructional handouts are one of the most effective way to help students deal with technology. Each student may have their own technology folder or "manual." The problem with this approach is that students often forget their folders and you have to end up storing them in the classroom. Another option is to create a notebook for each technology that contains basic instructions specific to the system. For example, the computer connected to the scanner would containing a scanning page. The LaserDisc player would contain guidelines for reading bar codes. Things that can be included in notebooks and manuals include guidelines for loading CDs and LaserDiscs, using specific software, disk management (i.e., formatting disks, naming and saving files and folder, and printing).

Once you've provided a demonstration and some step-by-step instruction sheets to get them started, most students can work independently. It's a good idea to make certain they've done some planning before starting up the technology. For example, students may brainstorm key words, narrow words, broad words, and related words that might be using in their exploration. Some students prefer to visualize their ideas in the form of webs, charts, or outlines, while others like the structure of research questions.

Also ask them to plan for storage of information. In other words, when they find interesting Web sites, how are they going to record the information? They could download information into their folder or e-mail account, print the information, take notes in a word processor, or take pencil and paper notes. Remind students to keep a log of sites, CDs, and other resources that they use just as they would create a list of print resources.

Conclusion

This session demonstrates how to design and develop active learning environments for children through using a variety of informational, instructional, communication, and motivational resources. It's essential that educators value all forms of technology. Low- and high-tech resources from books to virtual field trips have an important role to play in today's teaching/learning environment. Start today, using the technology you have. Start small, using the resources you have as a foundation. Plan carefully, considering the special classroom management concerns of a multimedia classroom. There are thousands of kites to fly. If you select your kite carefully, you'll have a great time flying!

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Additional information and project ideas can be found in Lamb, Annette (1996). Building Treehouses for Learning: Technology in Today's Classroom, Evansville, IN: Vision to Action.

Paper

Using the Web for Teaching: School and Community Sites

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Abstract

Teachers and health education professionals can use the World Wide Web for teaching. First, a community education effort is described to reach women concerned about breast cancer. A key concern in preparing such a Web site is that of access—can the intended audience gain easy access to information resources? Secondly, the Web is used to augment classroom instruction by making course materials available electronically. The key concern is whether instructional resources can be expanded by encouraging use of Internet resources through pre-selection.

The rapidly changing technological developments in the area of telecommunications and computing in the late 20th century have revolutionized the way that human beings communicate with one another. Just as the development of the printing press by Gutenberg in the fifteenth century resulted in books for the common man and the development of the telephone in the nineteenth century revolutionized personal communications, recent developments in emerging technologies have resulted in new communication and education paradigms. These new paradigms embrace new technology and capitalize on its strengths. In particular, the use of Internet resources gives educators the ability to present both new and familiar educational materials in any subject to students in an innovative way over the network. Widely available Internet resources can now be used effectively to educate individuals both in and out of formal educational institutions.

This paper describes two ways for teachers and health education professionals to use the World Wide Web for teaching. In the first instance a community education effort will be described that is intended to reach women concerned about breast cancer and assist them in locating information appropriate to their health needs. A key concern in preparing such a Web site is that of access—can the intended audience gain easy access to information source? And, is the information thus made available worth the effort of seeing information in this electronic fashion? In the second instance, the World Wide Web has been used to augment classroom instruction by making course materials available electronically. The key concern here is whether instructional resources can be expanded for students in "traditional" scheduled classes by encouraging use of Internet resource through pre-selection.

The World Wide Web as a Resource for Education

The World Wide Web, a part of the Internet that has a graphical, point-and-click user-friendly interface, can be used effectively as a tool by educators to disseminate information to audiences as narrow as a single classroom, or as broad as the world. For classroom use, teachers may provide a variety of course descriptive materials online, develop innovative computer-based instructional materials and provide access to resources located on servers around the world via the Web. As a global educational tool, the Web can provide a wide range of information and resources to the public in an easy to use format from a single starting point, the Home Page. Through the use of other network resources such as electronic mail, individuals world-wide can share their knowledge and experience. Thus, the Internet is an important tool for teachers in a formal educational setting as well as an important educational resource for the general public.

The strengths of a World Wide Web information resource for the general public are numerous. First, it is user-friendly and can provide a comprehensive and accurate resource for individuals world-wide. An example of a public information resource on the World Wide Web is The University of Minnesota Cancer Center Home Page. This resource, designed to help cancer patients and their families, draws on the strength of the body of knowledge and state of the art expertise of medical, education, and research personnel at the University of Minnesota. It also provides a valuable link between the University of Minnesota and health care professionals providing a link to up-to-date cancer information for outstate practitioners. The University of Minnesota Cancer Home Page broadens the educational scope of the University of Minnesota Cancer Center for the public, patients, their families, and practitioners.

A breakthrough technology, the World Wide Web is rapidly growing in use and acceptance. The number of women currently using the network has increased from a ratio of nine male users to every female user to two male users to every female user (Lewis, 1995). A public information resource such as the University of Minnesota Cancer Center Home Page fosters the coordination of basic and clinical research, improves patient care through the dissemination of timely information, and provides a central source of accurate educational materials to cancer patients and their families.

Access Issues

The greatest potential limitation inherent in the development of this type of educational resource for cancer patients is that its use is restricted to people who have access to the technology.

> As more cancer information is anchored to databases, often the quickest way to acquire it is through the Internet, the global network of computers. But because many Americans lack access to the Internet, or even to a computer, public libraries are working toward becoming information equalizers, to reduce the gap between cancer information "haves" and "have nots" by providing access to information on the Internet (Nelson, 1995).

Since computer ownership is more prevalent among upper class women, a concern that needs to be addressed is that underprivileged women are potentially left out. This limitation has been the focus of a number of articles which forecast the development of a society that is stratified by technological skills, knowledge, and computer access into the "haves" and "have-nots" (Negroponte, 1995). Currently, there are grassroots efforts to provide more public access to technological resources and to educate minorities in computer skills (Gardy, 1995). The need for increased public access to the Internet is being addressed by many states and municipalities with the installation of computers connected to the Internet in public areas such as libraries. For example, New York has a program called the Global Access Information Network (GAIN), Maryland has the "Gateways" project (Nelson, 1995), and Blacksburg, Virginia is in the process of creating "Virtual Blacksburg" to put the entire city online and connect its residents. Blacksburg provides free computer training and access for its citizens in municipal buildings. Colorado plans to put four personal computers in libraries in each rural or frontier county (Nelson, 1995). Iowa has installed a fiber optic network in its state-wide library system and the University of Iowa has developed the "Virtual Hospital" for continuing medical education and patient information (Nelson, 1995). Other states, such as Kentucky and Minnesota offer reduced rate Internet connections to alumni and "friends of the University" using existing University computer resources.

Minority access to online resources is a concern that is currently being studied. Based on a survey of 55,000 households in 1993, the Census Bureau estimated that 37.5 percent of whites were using computers at home, at work or in places like public libraries compared with 25 percent of blacks, and 22 percent of Hispanic people (Williams, 1995). It is unclear whether this difference is "due to technophobia, job patterns (for example, professionals use computers more than laborers do), or priorities that place computers near the bottom of the list of necessities. African Americans who champion the merits of new technology say that no one can afford to ignore it (Williams, 1995). To combat this problem, groups of African American journalists, engineers, and computer-service providers are beginning to hold forums, private meetings, and online conversations across the country to discuss ways to get more African Americans wired in, with the goal to demystify computers and help people use technology to simplify their lives. Groups of computer professionals in the minority community have also formed volunteer groups to teach computer classes after hours. Finally, in order to insure that technology is available to everyone, some African American politicians and community leaders are seeking public and private financing to establish information centers in churches, libraries and community centers to provide greater access to computers (Williams, 1995).

Advantages of the World Wide Web

The World Wide Web is different from other Internet media since it incorporates text, sound, video, high-resolution graphics, animation, and still photograph files into one seamless, transparent, and user-friendly application. The user accesses World Wide Web sites through the use of browsing software applications such as *Netscape*, *Lynx*, and *Mosaic*. These applications link sites locally or internationally through the use of hypertext "hot links" which appear in a different color from other text in the documents. By clicking the computer mouse on these "hot links," the user jumps from site to site to access information relevant to the topic of interest. The hypertext provides a link to other related documents.

As a part of the Internet, the World Wide Web, is a widespread information resource in cyberspace that is inexpensive and easy to use. It has the capability to provide a consistent interface to other information systems such as Gopher, a menu-based resource; Wide Area Information Servers (WAIS), which allow keyword searches; File Transfer Protocol (FTP); and USENET newsgroups. The Web is accessible through virtually all current computer platforms.

Cyberspace

The term "cyberspace" originated in science fiction literature produced in the 1980s. Although the term lacks a precise definition, according to David Ronfelt (1992) it has come to be the preferred term for envisioning the electronic stocks and flows of information, the providers and users of that information, and the technologies linking them as a new realm or system that has a functioning identity as significant as an economic or political system.

Initially cyberspace was the elite realm of military personnel, scientists, and academicians who used the Internet to collaborate and to communicate research findings with one another. The Internet, a loose network of thousands of computers located all over the world, may be visualized as a "cloud of resources encircling the globe" (LaQuey, 1993). It provides a powerful, international communications network and allows scientists access to expensive hardware resources. This giant network comprised of thousands of networks functions due to the interoperability of its numerous components. "Interoperability is the capacity of many diverse systems to work together to enable communication. It can occur only if the computers and the network hardware adhere to certain standards" (LaQuey, 1993). These standards are the protocols, TCP/IP or Transmission Control Protocol/Internet Protocol, necessary for computers with mismatched operating systems to send and receive messages from one another. By providing a fast and efficient global means of communication, the Internet has transcended its original purpose. Today the Internet is not only used as a communications tool by military personnel, scientists, and academicians but also by the business sector, educators, students and ordinary citizens via commercial online and telecommunications services.'

Precursor Events

The development of an affordable microcomputer in the 1980s, a precursor event, resulted in the proliferation of the computer in the business environment, in educational settings, and in the home. According to Nicholas Negroponte (1995), director of MIT's Media Lab, 35 percent of households have at least one computer and 70 percent of PC sales this year will be home computers. These statistics are indications of an important social trend. An increasing number of people of all ages are becoming computer literate, and potentially have access to the resources available online.

> The fall in the cost of computer and telecommunications hardware, along with increased ease of access to the Net is resulting in a dramatic increase in the size of the electronic community. The Web is further fueling this trend. It is being seen in many quarters as the universal, user-friendly front end to the Internet and as a tangible manifestation of the Clinton administration's idea of the Information Superhighway (Ford, 1995).

Until recently, Internet access for the average user was difficult. The increasing interest of the business sector in Internet use created demand for the development of navigation software and a user-friendly interface. The World Wide Web is different from other Internet interfaces since it incorporates text, sound, video, high-resolution graphics, animation and still photograph files into one seamless, transparent and user-friendly application. The user accesses World Wide Web sites through the use of browsing software applications such as *Netscape, Mosaic, Lynx, Cello,* and *MacWeb.* These browser applications, available to consumers free of charge over the network, link sites internationally through the use of hypertext links "hot words" which appear in a different color or punctuation from other text in the documents. The initial access point for Web users is a "Home Page"—a computer screen at a World Wide Web location that is analogous to the table of contents in a magazine. It may contain text, colorful graphics, and "hot word" links. The Home Page provides an enticing glimpse of the various types of information which may be accessed from that point, and functions in a way similar to a menu screen. With the click of the computer mouse on these "hot words," the user jumps from site to site to access information relevant to the topic of interest. Through the use of these hypertext links, a Web Home Page is able to communicate a large amount of very detailed information to a client who actively seeks the desired information at his leisure through his computer. Virtual communities of people with similar needs and interests have developed. These communities communicate online through listservs and newsgroups. Listservs can be used by classroom teachers as an effective educational tool. Using a class listserv as a forum for online discussion, teachers may post questions to be answered by members of the class, and require that students both answer a number of questions electronically as well as respond to their classmates comments.

Education Online

"Creating online documents, especially those incorporating new media, demands new knowledge and skills" (Horton, 1994). Online documentation is primarily a visual medium and relies heavily on drawings, diagrams, photographs, charts, tables, and lists. In the construction of Web documents, educators may identify critical elements of knowledge and use various computer software applications to effectively present material for retention and transfer of knowledge to the learner. With multiple links to various documents and other resources, students can access material of different levels of complexity and depth.

Use of the computer for educational programs also ensures that each student receives the same instruction and may repeat sections of the program as many times as needed for understanding. The student may advance through the information at his own pace, in a private setting, then generate written print-outs of instructions or assignments. Through the use of electronic networks such as the World Wide Web, students may access large databases of information from multiple international sources quickly, easily, and over a period of time. They can also use listservs, discussion groups, and e-mail to communicate with others who share similar needs and concerns.

The computer is an important tool for education professionals, especially educators who work in isolation in rural areas without adequate information resources. For these professionals, the World Wide Web provides a powerful and convenient source of current information. Through the use of electronic search tools and databases such as ERIC it is possible to locate publications online in a matter of minutes. It will also provide a forum for the exchange of ideas. Through the use of network tools such as listservs and discussion groups, educators may consult with colleagues, and rapidly share new knowledge and techniques to a broad audience. With its multimedia capabilities, the World Wide Web, can be utilized to disseminate digitized images adding another dimension to this valuable resource.

Hypermedia

What makes the Web powerful is a software technique known as hyperlinking. In the composition of a page for the World Wide Web, an author uses Hypertext MarkUp Language (HTML) to create hyperlinks—words that appear in a different color or bold type and indicate a link to some other information. Hypertext is a means of accessing information that is stored in diverse locations in a way that is independent of the user's need to know where the information is located. With the click of the mouse the user can access the information contained in the hyperlink—whether it is contained in the same system as the initial page—or residing on a computer server located on the other side of the planet.

Hypertext, a subset of hypermedia, refers specifically to computer-based documents in which readers move from one place in a document to another or between documents in a nonlinear or nonsequential manner. This means that the reader doesn't access information in a traditional beginning-to-end fashion. In a nonlinear computer document, the user moves randomly through the document. Words, phrases, and icons in the document become links that enable the user to jump at will to a new location in the document or even to a new document. Part of the power of the World Wide Web is that the user has a simple, single point and click interface to the vast body of information located on the Internet. Other Internet software resources such as Gopher, which has a menu interface, and WAIS (Wide Area Information Server), which conducts searches based on keywords, provide the user with singular search capabilities. Through the client-server architecture of a Web browser, the user has a seamless, transparent interface to both hypertext and non-hypertext systems.

The advantages of a hypertext system such as the World Wide Web as an educational resource for health care professionals were recognized and introduced by The Case Western Reserve Medical Education System in 1955 (Henry, 1990). Their system embraced elements of hypertext emphasizing organ systems and disease through an integrated curriculum. The use of hypertext in their instructional system allowed students to see the relationships both within a discipline or body of knowledge and to connect different bodies of knowledge to gain a wider view. Students were able, through the capabilities of the computer, to navigate and browse through varied materials. This activity is similar to reading an article and then going to the library for citations and further definitions or references (Henry, 1990).

Thus, the hypertext format of the World Wide Web has important advantages for users. First, hypertext provides an effortless point and click means of navigation between both documents and topics. Since the construction of the links between topics and documents is not hierarchical, the user can rapidly follow ideas as the thoughts emerge. It is the user, not the computer systems administrator, that decides which information is important and in what sequence it will be called up to the computer screen. Hypertext and hypermedia also allow the user to browse through a large quantity of information located at various sites quickly. It is very easy for the user to follow cross-references. The hypermedia aspect of the World Wide Web provides graphical, audio and video information along with textual information, which clarifies concepts visually in a way that text-based information alone cannot. Hypermedia also facilitates cognitive flexibility because it allows a topic to be explored in multiple ways, using a number of different concepts or themes. Integrated multimedia environments, such as the World Wide Web, bring together the symbolic and processing capabilities of various media to help learners connect new knowledge to old knowledge (Kozma, 1991).

Classroom Use

As a classroom tool, the World Wide Web provides a means for educators to post all of their class materials online and to provide students with access to Internet resources at other institutions and remote sites around the globe. One advantage to this approach is that students are able to review course materials online prior to course registration and to evaluate which courses best fit their needs. Another advantage is that all of the information that students need to complete the course requirements is easily accessible at any time from a central source.

Through the use of hypertext links, teachers can utilize Internet resources from a variety of institutions and link reading materials such full-text journal articles to the class home page. Not only is paper saved by avoiding the copying of library materials, but more current periodical literature can be made available to students than is otherwise possible. These are resources that may be difficult for students to find on their own, and the manuscripts are likely to be more timely than if persons had to wait for their arrival through traditional print journals. Even refereed material can be made available more quickly electronically than it could in paper print form.

The course materials for two class designed for pre-service teachers in the business education field have been prepared for distributed through World Wide Web pages. All descriptive class materials including the course title, description, syllabus, requirements and schedule, previously distributed to students in print, are available online. Contact information for the professor including office location, office hours, telephone number and e-mail address are listed. The Home Pages are organized in three main documents: Course Description, Course Requirements, and Course Schedule. Students can move easily through these documents to access the course description and objectives, course requirements, including assignments, grading criteria, guidelines for assignment completion, Internet access information and course policies.

Hyperlinks to bibliographies provide students with a reference lists which enable them to complete written course assignments. The course schedule includes hypertext links for each class meeting. By clicking on a specific meeting date, students can access each week's reading assignments (paper-based and electronic) and a list of assignments due that day. Additional links within this file allow point-and-click access to Internet resources located at remote sites around the world. For example, students can link to the National Center for Research in Vocational Education Home Page at the University of California, Berkeley. From this, and other sites, students can access complete online publications and documents to complete reading assignments. The use of the World Wide Web as an instructional tool allows the professor to post all course information online, to update it easily, and to permit—even encourage—students to readily utilize Internet resources. It immediately conveys the message that the Internet is indeed a course resource ready for students' immediate use.

Community Education

The University of Minnesota Cancer Center Web site has three main objectives. These objectives include provision of basic information about the Cancer Center itself and information for patients and their families about the disease of cancer, its treatment, and current advances in research. The final objective is for University of Minnesota researchers to access and share information with other professionals worldwide.

Home Page links are provided to three different categories of information about the Cancer Center. The first category is the Cancer Center Information Guide which provides basic information about the Cancer Center itself and includes a photograph, map, location, mission, departments and staff specialties. The second category includes information about the diseases and their treatment, treatment options, general recommendations for prevention and recent findings. Other information is of personal benefit to patients and their families, such as information about national and local support groups, the Ronald McDonald House, Frequently Asked Questions, and educational programs. The hypermedia aspect of the World Wide Web is particularly valuable for this type of project because through a simple point and click of the mouse on hyperlinks, definitions, video, graphics, and sound files may be retrieved quickly and easily to clarify concepts for patients in very concrete ways. For example, photographic images of microscopic slides show the difference between normal and cancerous cells visually. The third category of information provided by the Cancer Center Home Page is for medical professionals and researchers. This category includes recent findings, links to abstracts and full text papers as well as other resources such as the National Cancer Institute and the National Institutes of Health. Since this type of information is rapidly changing, it is particularly efficient to disseminate timely information electronically rather than in print materials.

Patients with computers, Internet access and World Wide Web browser software in their homes or places of business are able to access this resource at their leisure 24 hours a day. This feature of Internet use provides the advantage of time and privacy. The information provided has the potential to help patients deal with emotional trauma, learn more about the disease, and learn how their lives will be affected, as well as explore treatment options.

The World Wide Web is a resource that is widespread and easy to use due to its graphical point-and-click user interface. This resource can be effectively used an as educational tool by teachers in formal school settings and in the community for public health information. The challenge is to provide regular and easy access to appropriate technology and to develop and maintain current information resources through Home Page creation and regular updating.

References

Ford, A. (1995). Spinning the Web: How to provide information on the Internet. London: International Thomson Publishing.

Gardy, A. (1995, March 12). Forging links between inner cities and the Internet. The New York Times, 10.

Henry, J. B. (1990). Computers in medical education: Information and knowledge management. Understanding and Learning, 998–1002.

Horton, W. (1994). Designing and writing online documentation. New York: John Wiley & Sons.

Kozma, R. B. (1991). Learning with media. Review of Educational Research, 61(2), 179–211.

LaQuey, T. (1993). The Internet companion: A beginner's guide to global networking. Reading, MA: Addison-Wesley.

Negroponte, N. (1995). Being digital. New York: Alfred A. Knopf.

Nelson, C. (1995). Libraries face challenge of providing computer access. Journal of the National Cancer Institute, 87(6), 410–412.

Ronfelt, D. (1992). Cyberocracy is coming. The Information Journal, 8, 243–296.

Williams, L. (1995, May 25). Computer gap worries blacks. The New York Times, B1.

Focus

Internet in Business Courses: High School, Technical and Community College Focus

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Key Words: **articulation, business, careers, integration, internet, marketing, policy**

Business programs that prepare students to become economic citizens as well as to become qualified for entry-level business employment are available at three levels in Minnesota: high school, technical college, and community college. Teachers at all three levels are facing the challenge of integrating networks into business classes. Students in all three settings currently have access to well-equipment computing facilities and receive in-depth instruction in business microcomputer applications. Using the Internet is a necessary adjunct to this preparation for employment settings where computer use will be a primary part of the job.

This panel of business teachers has representatives from all three levels, plus a fourth representative from the University of Minnesota who works with teacher preparation for all three sites.

The panel will present perspectives from business teachers all three teaching levels, plus teacher preparation, around the following issues related to using the World Wide Web for teaching and learning:

- Student Access to the Internet: E-mail Addresses and Access to Computers: Participation in School-Wide Policy Development for Appropriate Access
- Integration of Internet Use into Existing Classes or as a Stand-Alone Course: Support for Existing Business Instruction, or Service to the School on Internet Use?
- Student Collaborative Relationships with other Students and Leaders in Business: Links with other Schools, Links with Community (and beyond!) Business Leaders
- Student use of Business Listservs and/or Business Newsgroups: Information Overload or Access to Discussions for Learning?
- Business Information Access on the Internet: What topics? Which Search Tools?
- Analysis of Marketing on the Internet: Who is doing the Marketing? What is their Appeal? Is This a Business Opportunity for Students?
- Student Exploration of Career-Opportunity Announcements on the Internet: Where are the Jobs? What are the Job Requirements?
- Student Creation of Web Sites: Who is the Audience? What are the Messages?
- Instruction in Business Topics Using the Internet: Using the Internet to Teach Business Telecommunication Applications
- Program Articulation: Post-Secondary Opportunities to Build on High School Preparation

Society

Some Implications of CyberSchool (ACM SIGCUE)

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Key Words: **Internet, distance learning, new instructional methods, world wide classroom**

The world wide expansion of the Internet is facilitating profound change on teaching and learning. For the first time in human history, the geographical location of the teacher, the student, and the learning materials are nearly insignificant factors. This fact alone provides the possibility of profound change in the business of instruction.

Imagine, if you will, a typical class discussion in an American high school. Most of the students in the room are the same age, were raised in the same area, come from families at the same socioeconomic level, and have the same language, religion and basic world view. They are discussing World War II. Now imagine this same discussion if some of the students are in their home or school in Nagasaki, and others are in Berlin, Beijing, Moscow, London and Pearl Harbor. Now also imagine that students have convenient access to an exploding amount of original source materials (text, pictures, film) from that era as well as access to people who actually participated in the events under discussion. Of course, through the Internet, this is all possible today, right now.

What will be the role of the instructor who teaches in this new environment, this cyberspace? Perhaps even the terms "instructor" or "teach" are not precise enough to describe what this person will be required to do. Whatever we call him or her, and whatever we call what they will need to know how to do; it is clear that he or she will need an additional set of skills to flourish in this strange (and exciting) new world.

The teacher may well become a cyberspace hired gun. "Have computer, will telecommute," as the motto on his/her home page business card. It will not take long for the education establishment to realize that they can hire teachers from anywhere on the planet, with virtually any kind of experience, educational philosophy or credentials. They most likely will not have to negotiate with a union to hire them, will not have to pay them benefits, will be able to easily monitor their performance, and will be able to add or subtract their services in single student increments.

Likewise, it will not take long for teachers to realize that they can live where they wish, teach only the courses they like, avoid lunchroom duty, and feel safe from bullies, guns and drugs. They may also free themselves from the curricular whims of department chairs, school boards, departments of education, state legislators and federal bureaucrats. And, if the educational establishment does not come to see the advantages of the cyberteacher, The Discovery Channel or Scholastic or Microsoft may.

The entrepreneurial teacher may have to deal with numerous contracts. He/she may be a consultant to a local company to prepare materials for employee training; may teach face to face on a part time basis for the local school district; may teach a cybercourse for a provincial department of education; and may even franchise proprietary course methods/materials to other cyberteachers.

In any case, the cyberteacher of tomorrow will have to be technologically savvy and will spend a significant portion of their time constantly retraining themselves. They will continually reconfigure their teaching strategies to take advantage of emerging learning theory, hardware and software.

The role of the student in the world wide Internet classroom may change just as dramatically. The student (under the supervision of their parents) will become educational consumer rather than an educational product. Students and their parents will shop for educational experiences the way they might shop for any expensive important item. Some of those experiences will be face to face with teachers, while others will be through the Internet with international classmates. A portion of the school day may be supplied by the local school district, a portion will be supplied by a distant CyberSchool, and, even yet another portion will be supplied by institutions not normally thought of as schools. Choosing a home based on the quality of the nearby schools will seem increasingly strange as students continue to break their geographical shackles.

Of course, the nature of the Internet will also influence the nature of the instruction. As the Internet allows schools to give up their addiction to textbooks, classes will no longer resemble the Platte River (an inch deep and a mile wide). Instruction may become:

- based on communication and collaboration rather than power and competition;
- concerned with solving problems and creating things rather than meeting standards and certifying students;

- process-centered rather than test-centered;
- concerned with access, manipulation, and presentation of large amounts of information rather than concerned with mastery of small amounts of preselected information;
- student-centered rather than system-centered.

Focus
Internet Cum Laude: The Virtual University

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Key Words: **distance learning, Internet, virtual university, teacher education, electronic field trips**

Overview

The next logical step for distance learning is the virtual classroom. As multimedia information access becomes faster and easier online education becomes one of the newest and most exciting new environments for learning.

Currently, many universities are taking advantage of the Internet for providing useful scholastic information and data to students and the general public. World Wide Web sites at these universities and colleges have information on the university/college and courses offered. Some colleges make available online curriculum created with the Web's HTML programming language.

Students are taking advantage of wired universities to Telnet to libraries and access online card catalogues to research information. Other students are taking advantage of Internet access to find jobs, research information, download free journals and periodicals, and to communicate with others around the world.

Many college classes are using electronic mail (e-mail) as a new medium for communicating with students. Some classes have students take electronic field trips to sites such as NASA, the CNN Center in Atlanta, and virtual museums around the world. Still others are providing students with links to Internet resources relating to their majors and class studies.

This presentation will discusses an online distance learning class for educators on the Internet. *Internet For Educators*, is a three-credit course offered by Educational Management Group of Phoenix, Arizona. Dr. Cynthia Leshin has designed this class using interactive instructional video, satellite presentations, electronic conferencing, e-mail, and the World Wide Web. Fifteen instructional videos were produced.

Each week an instructional video is broadcast to the school where teachers have registered for the class. The instructional videos consists of 30 hours of video seat time and approximately 45 practicum hours. Students use the Internet to research information, to interact with colleagues around the world, and to find collaborative classroom projects. Other educators who are not classroom teachers design their own research and projects based on their professional needs and goals.

Class Interaction

The *Internet For Educators* class has been designed to be highly interactive. We believe that the most valuable learning experiences are when we can share information and learn from others. This class uses three telecommunication tools for interaction and communication: electronic mail, the Internet Academy Electronic Forum, and live satellite broadcasts. E-mail is used for communicating with the instructor and for creating a paperless environment. The electronic forum is a place where students meet other students around the country taking the class. Discussion topics on the forum include "Children on the Information Superhighway," "Integrating the Internet into the Curriculum," and "Internet-Based Alternative Assessment."

Electronic Class Materials

Dr. Leshin has written *Internet Adventures—Step-By-Step Guide To Finding And Using Educational Resources*. In addition to using this book as a text for the course, Dr. Leshin has created a World Wide Web site where the newest teaching and learning Internet resources are made available. This Web resource takes advantage of the medium to always provide the newest and best Internet resources for teaching and learning. Additionally, the purpose of this Web site is to provide a place for busy teachers to find the best educational resources available on the Internet without spending large amount of time surfing the 'Net. Online curriculum and guidelines assist with using Internet resources as a learning tool in the classroom.

Focus

Teaching Teleapprenticeships: Linking Schools, Universities, and the World

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Key Words: **telecommunications, networks, teacher education, K–12**

"Teaching Teleapprenticeships" are learning frameworks which link university students and faculty with K–12 teachers and students to improve education in both settings. These frameworks are valuable because they provide authentic contexts for learning. "Teaching Teleapprenticeships" also provide a scalable mechanism for engaging the human resources needed to use the new world-wide information infrastructure widely in education.

In this focus session, we will describe the development and evaluation of a wide variety of Teaching Teleapprenticeship learning frameworks. We will report on our four-year study of "Teaching Teleapprenticeships" in a number of different courses and programs at the University of Illinois and on the impact these activities have had in K–12 education. We will present examples of how these frameworks have improved teacher education, and how activities of teacher education students have provided valuable mediation for K–12 teachers and students in accessing, evaluating, and producing network resources.

By participating in these "Teaching Teleapprenticeship" frameworks, students have moved beyond "surfing" to "serving," providing valued resources for interlinked people and organizations across the nation and around the world. When these frameworks are embedded in existing courses and curricula, both higher education and precollege education can work collaboratively to restructure learning.

Society

How to Build Your Own Local Area Network (ECMI)

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Key Words: **LAN, Ethernet, TCP/IP, PPP, Internet**

This presentation introduces the design and implementation of a low cost local area network (LAN) of PCs and Macs with access to Internet and other existing networks.

We will discuss procedures for selecting, installing, and integrating all necessary hardware and software components according to the Ethernet/IEEE 802.3 and TCP/IP standards. The hardware components include network interface cards, cables, hubs and routers. The software packages include *NCSA Telnet* for PCs (DOS), *NCSA Telnet* for Macs, and *WINSOCK* for *Microsoft Windows*. In addition, we will also show how *Windows 95* and *NT* (from the Microsoft Corporation) may ease the networking tasks and various ways to link a standalone computer or an isolated network segment to the Internet using PPP (point-to-point protocol).

To those who may already have networks installed, we will show how TCP/IP network protocol can run concurrently with existing network protocols such as IPX (from Novell Corporation) and how to select and integrate new 100-Mbps networks to fill the network bandwidth needs in multimedia network applications of the future.

Paper

A Managerial Analysis of ATM in Facilitating Distance Education

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Key Words: **asynchronous transfer mode, computer networks, distance education, telecommunications, technological planning**

Abstract

In this paper, the fundamental characteristics and capabilities of ATM (Asynchronous Transfer Mode) networks in a distance learning environment are examined. Current and projected ATM applications are described. Issues and challenges associated with developing ATM networking solutions for instructional delivery are explored. Guidelines facilitating ATM implementation in the educational setting for instructional enrichment are presented.

Introduction

ATM (Asynchronous Transfer Mode) is a connection-oriented, multiplexing and switching technology that is uniquely suited for the development and implementation of multi-service broadband networks. With its promise of universal connectivity and projected ability to seamlessly link faculty, students, and resource material at diverse locations in high quality educational environments, ATM is viewed as a key enabler for distance learning and networked multimedia and virtual reality applications.

Pilot networks such as BAGNet (Bay Area Gigabit Testbed Network) (*http://george.lbl.gov/BAGNet.html/*), BEATMAN (Boulder Area ATM Network)(*http://www.cs.colorado.edu/%7Ebatman/Home.html*), and ATDnet (Advanced

Technology Demonstration Network) (*http://www.atd.net/atdnet.html*) are testing ATM operations in facilitating research initiatives that include telelearning and teletraining. CalREN (California Research and Education Network) participants including the University of California, San Jose State University, and San Francisco State University are exploring the use of ATM for videoconferences, teleseminars, teleconsultations, medical imaging, remote diagnostics, and statewide delivery of graduate programs in the field of library and information science (*http://www.pacbell.com/SuperHi/CalREN/Projects/*).

Although advances reflected in ATM technology create new opportunities for bringing leading edge applications to the desktop, the campus, and the wide area environment, debate continues in academic circles about whether the time is right to invest in ATM technology. An analysis of my case study research reveals various concerns among those investigating the feasibility of ATM implementation. Potential barriers include costs, functionality, absence of standards, and limitations on ATM's ability to integrate voice with other media. ATM technology is still in its infancy. Data and documentation on the effectiveness of ATM use in the educational domain are limited.

Questions that are integral to any consideration of ATM as a networking option for accommodating distance education include the following:

- What are the fundamental characteristics of ATM?
- How are institutions currently using ATM? What are some potential applications?
- What are advantages and limitations associated with ATM implementation?
- What areas of concern do educators have about ATM deployment?
- What are major ATM planning guidelines?
- Is ATM affordable?

This presentation addresses these questions, demonstrates the capabilities of ATM in the distance education environment, and presents strategies for ATM deployment.

Fundamental Characteristics of ATM

ATM is characterized by its high speed transmission efficiency in providing bandwidth-on-demand for multiple types of network traffic, and support for both private and public networks. ATM works at rates of 155-Mbps (OC-3) and 622-Mbps (OC-12) and is projected to reach 10-Gbps (OC-192). Optionally, ATM can also operate at 45-Mbps and lower rates.

At the core of ATM technology is a standard fixed sized 53-byte cell consisting of a 5-byte header and a 48-byte payload or information field. Since the cell length is constant and buffer memory size is always known for each cell, ATM-based networks switch information from source to destination very quickly. A multimedia application is made up of time dependent, continuous traffic such as video and audio and time independent traffic such as text. The ATM platform is designed to handle these elements equally well.

The terms "ATM," "cell switching," and "cell relay" are often used interchangeably. ATM has emerged as the technology of choice for next generation LANs (local area networks), MANs (metropolitan area networks) and WANs (wide area networks), and integrated networked environments.

Standards for ATM based integrated broadband networks are defined by the International Telecommunications Union-Telecommunications Sector (ITU-T), Internet Engineering Task Force (IETF), and the ATM Forum, an international consortium of vendors, governmental agencies, communications carriers, and end users. ATM can work over such physical media as copper and optical fiber and are being adapted to support wireless networks.

Applications

Distinguished by its projected capability for accommodating full motion video, audio, data, and images on the same network, ATM is designed as a universal transparent communications solution. With its capacity for supporting integrated services and real time-traffic requirements, ATM is expected to revolutionize instructional delivery to remote learners.

Operational since August, 1994, the North Carolina Information Highway (NCIH) is the first widescale public implementation of ATM technology (Patterson & Smith, 1994). According to Gary Munn (personal communication, June 8, 1995), Sales Engineering Manager with Fujitsu Network Switching, "the beauty about ATM use in the NCIH is its flexibility." Applications range from teleworkshops for physicians and medical students to virtual museum field trips offered by the North Carolina Museum of History so that students from outlying rural schools can participate in museum activities. In the metropolitan Wilmington area, a hospital serving as a node on the NCIH employs ATM by day for medical imaging and by night for delivery of advanced master's courses in nursing so individuals can upgrade skills and earn credentials on site without driving to the University of North Carolina at Chapel Hill.

Peggy Manring (personal communication, June 7, 1995), Head of the Distance Learning Department at the North Carolina School of Science and Math, indicated that videoconferencing is a popular NCIH option for delivering courses in history, psychology, and T'ai Chi to learners throughout the state. Manring noted: "Through handling full motion, real-time video, ATM facilitates the development of a collaborative learning atmosphere that resembles the ambiance found in a traditional classroom." NCIH is also designed to facilitate high speed connection to the Internet, thus allowing students to rapidly access large video and audio objects to further enhance the learning experience (*http://www.ncih.net/nciin/*).

NYNet is an ATM testbed in New York State providing high bandwidth connections for such institutions as Cornell University and Columbia University (*http://www.npac.syr.edu:80/users/hariri*). Projects in progress include development of approaches for incorporating virtual reality (VR) simulations into educational programs for students in kindergarten through 12th grades.

In Indiana, Ameritech introduced an ATM based network that will eventually connect approximately 1,700 schools to the Access Indiana Information Network (*http//www.ai.org/*) (Littman, 1996). This ATM network implementation will allow learners to virtually explore sites such as the zoo and art museum without incurring expense to the schools or disruption to the visited location.

In the field of telemedicine, ATM supports the transfer of MRIs and CAT scans between the Johns Hopkins University School of Medicine and the University of Maryland Medical Center. Neurosurgeons at the University of Virginia's Health Sciences Center use an ATM network configuration to consult with physicians at nearby health care facilities, thereby eliminating the need for patients or their doctors to commute between sites (Littman, 1996). LARG*net (London and Region Global Network), an ATM network linking the University of Western Ontario in Canada to three local teaching hospitals, enables health care training and research (*http://www.largnet.uwo.ca/*).

These examples of ATM in action are contributing to interest and enthusiasm in implementing telelearning applications. In a university setting, ATM paves the way for creating a technology mediated multimedia environment that can accommodate individual learning styles, skills, and competencies (Littman, 1995). ATM deployment can lead to telementoring, new instructional methods, teacher training, innovative models for courseware development and curricular delivery, and establishment of virtual classrooms across international boundaries. The learning experience in the classroom

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can be enhanced by providing access to high resolution images, large quantities of data such as geographic maps, and multimedia resources from virtual electronic libraries.

Advantages and Drawbacks

Expanded communications requirements and the demand for multimedia applications have contributed to the popularity of ATM technology. ATM provides a seamless integrated environment that optimizes productivity and resource sharing. ATM technology can co-exist with existing networks and does not require replacement of equipment already in place. Designed as a multi-service platform, ATM also supports implementation of such fast packet communications options as frame relay and Switched Multimegabit Data Service (SMDS).

An ATM network can be as small as a desktop or large enough to span the globe. ATM is noted for its high speed, reliable performance, and ability to handle delay sensitive and bursty traffic. Expectations are that ATM will serve as the foundation for an integrated LAN-MAN-WAN infrastructure by the turn of the century.

Despite the promise of ATM, there are barriers to ATM deployment. These include costs for equipment, communications, and operations; expenditures required for making the transition to the new technology; and lack of off-the-shelf availability of services and products. ATM operations, protocols, network topologies, and application requirements are still being defined. The standards are not yet complete.

Bill Jones (personal communication, June 8, 1995), network analyst at Virginia Commonwealth University (VCU), indicated that a critical factor in ATM assessment is clearly understanding technical specifications of the products under consideration. Jones said: "You must determine how products function in terms of your computer communications requirements." Jones pointed out that ATM is a fairly new technology. "Some products won't work on single mode optical fiber while other products won't work at all. In investing in ATM, you must make sure the product is in actual use and not vaporware."

ATM switches provide the underlying physical structure for the network configuration. The ability of ATM switches to sustain end-to-end network performance contributes to the importance of this emerging technology. Yet, there can be inconsistencies in the operation and performance of similar switches from different vendors in network installations.

Vernon Williams (personal communication, June 14, 1995), lead systems engineer and network architect with communications and network services at VCU, stated: "A serious limitation associated with ATM is the lack of comprehensive standards and cross vendor support. At this point, you are virtually required to use a single vendor to supply all of your ATM equipment in order to achieve full functionality."

With its capacity for high speed transmission, ATM appears to be the ideal solution for multimedia applications. However, another drawback of ATM is its currently limited capacity for carrying voice traffic. Nolle (1995) noted that General DataComm (Middlebury, CT) and Newbridge Networks (Herndon, VA) are among ATM vendors trying to correct this limitation. However, standards for voice transmission via ATM switching are not expected to be adopted until 1997.

According to Munn (personal communication, June 8, 1995), with ATM's assurance of instant connections, users are under the false impression that ATM technology supporting instructional delivery and videoconferencing will be as easy to use as making a telephone call. Munn observed: "In reality, there is a steep learning curve."

ATM is in a state of transition. Factors that can contribute to user acceptance include consistency of physical interfaces, acceptance of agreed upon standards, lowered implementation costs, and quality of service guarantees.

ATM Deployment Concerns

Created to facilitate deployment of broadband communications networks, ATM is making the transition from theory and pilot tests to practical use. Despite ATM's potential for supporting instructional delivery, research, collaboration, and worldwide information exchange, an analysis of the discussions I have had with university leadership indicates that managers are reluctant to implement ATM fully until the technology becomes more mature and affordable.

The University of Minnesota Medical School links metropolitan hospitals over an ATM network to provide education to medical residents and deliver distance training to physicians in the field. Will Murray (personal communication, June 14, 1995), senior systems programmer with university networking services at the University of Minnesota, noted: "In terms of campus activities, we have had success in using ATM for pilot projects involving such high bandwidth implementations as 3-D molecular modeling. We will seriously look at ATM for our campus backbone network once the standards are more clearly defined and products are more readily available."

Steven Zink (personal communication, June 9, 1995), Associate Vice President for Information Resources and Technology at the University of Nevada, said: "In preparation for ATM, we have wired our campus with optical fiber. Although we plan to implement ATM, we don't want to be on the bleeding edge." Bill Bard (personal communication, September 1, 1995), telecommunications manager at the University of Texas at Austin, noted: "ATM poses technological uncertainties. We are presently using ATM for test purposes to discover if it works."

ATM usage also poses important pedagogical questions in relationship to distance education. What are the implications of ATM paradigms for the educational community? Should an ATM enabled virtual university replace a physical campus site? What are the merits and limitations of ATM implemented distance education sessions in comparison to traditional classes? What factors can contribute to effective teaching and learning in an ATM virtual classroom? Can ATM facilitated instruction accommodate diverse student and faculty abilities, motivations, and personalities? What re-orientation will be necessary for faculty who have resisted the use of electronic tools and techniques for either educational or personal reasons?

ATM technical issues are complex. The pedagogical questions associated with the educational use of ATM are multifaceted. In planning the migration to ATM, managers must ensure that expectations concerning ATM are realistic, promote understanding of ATM capabilities and applications, and address instructional concerns.

Planning Strategies

ATM is an emerging technology. The ATM infrastructure is intricate and detailed. How can managers develop ATM networking capabilities? What kinds of strategies can ensure that ATM contributes to effective educational outcomes? Is the cost/benefit relationship associated with ATM implementation strong enough to warrant a commitment of university funding? Does the technology satisfy institutional requirements?

Robert H. Evans (personal communication, June 12, 1995), Professor of Meteorology and Physical Oceanography at the University of Miami Rosensteil School of Marine and Atmospheric Science, is working on a pilot ATM project that involves the use of data from satellites to study ocean phenomena. Evans said: "A knowledgeable user can achieve fairly credible results with ATM, but ATM is clearly not a plug and play environment." He added: "If I were a new user, I would definitely want to work with experienced individuals to ascertain the applicability of ATM and the present generation of software and hardware to the kinds of problems that I intend to solve."

In evaluating the suitability of ATM for the university environment, the need for ATM and its priority in relation to other computer communications requirements should be addressed initially. Applications selected for implementation should cost justify the expense of ATM investment.

Williams (personal communication, June 14, 1995) recommended a phased implementation. "At VCU, we are exploring the implementation of ATM supported multimedia classrooms at libraries on our medical campus and academic campus. Although ATM will play a key role in distance education, it will be pricey in the near term." Williams underscored the necessity of questioning vendors about the capabilities of their products. He noted: "It is important to be well versed in ATM technology and to compare services and offerings from several vendors. Don't stop your investigation after talking to the first vendor."

Questions that can aid in evaluating ATM viability include the following:

- What are the primary goals and objectives for an ATM implementation?
- What kinds of instructional applications can be enabled by ATM currently and in the future?
- What are the advantages and drawbacks of ATM in terms of present-day and long term technical and educational specifications?
- What expenditures are involved in a migration to ATM?
- How can ATM be integrated into the existing campus network infrastructure and facilitate distance learning?

A feasibility study can establish with greater accuracy the likely success of ATM deployment. Questions that can aid in conducting the feasibility study include the following:

- What are the total estimated costs for ATM implementation?
- Can ATM support existing and projected instructional applications?
- Can ATM contribute to the design of an effective learning environment?
- Are expectations concerning ATM educational benefits reasonable?
- Are university traffic requirements suitable for ATM deployment?
- What kinds of security mechanisms are available?
- Can ATM facilitate interoperability across diverse computing platforms?
- Are products from ATM vendors compatible?
- Are attitudes of key decision-makers positive toward ATM?
- Is there grassroots support for ATM?
- Is the time right for ATM deployment?

On the basis of the feasibility study, a decision can be made to implement ATM or discontinue the investigation. A report reflecting inputs from the feasibility study that can help in the decision-making process should highlight such factors as:

- Initial capital outlay
- Recurring expenses
- Resources required
- Anticipated educational applications and

- Benefits and limitations

The report should also feature an initial assessment of the projected ATM configuration in terms of criteria such as the following:

- Pricing
- Hardware and software features and capabilities
- Communication services
- Maintenance and operations requirements
- Adherence to standards
- Vendor and product reputation
- Training, instruction, and user support and
- Customer references

If the decision is made to proceed with ATM deployment, a request for proposal (RFP) can be developed for distribution to equipment vendors and communications carriers. Equipment vendors active in this field include Bay Networks (Santa Clara, CA), Cisco Systems (San Jose, CA), Digital Equipment Corp. (Maynard, MA), FORE Systems (Warrendale, PA), and 3Com Corp. (Santa Clara, CA). Communications carriers such as AT&T, GTE, Sprint, and MCI provide ATM services to educational institutions. RBOCs (Regional Bell Operating Companies) featuring ATM for universities include Bell Atlantic, BellSouth, NYNEX, Pacific Bell, Southwestern Bell, and US West. European network operators currently testing ATM technology across national boundaries include England's British Telecom, Germany's Deutsche Bundepost Telekom, and Spain's Compania Telefonica Nacional de Espana.

Another option for ATM implementation is outsourcing. Outsourcing involves contracting a vendor or communications carrier to build and deploy an ATM solution. For example, Ameritech configures and implements an ATM based network to accommodate institutional requirements. Ameritech also provides ATM equipment and communications services at a set lease fee, thereby eliminating the need to make a capital investment; monitors the installed ATM network, thus ensuring the integrity of information communications; and furnishes maintenance and support services.

Expenditures

The ATM market is in a state of flux. Costs for some ATM products that contribute to the development of an ATM configuration are decreasing, but the total outlay for an ATM network remains substantial. According to McQuillan (1995), prices for 25-Mbps ATM adapters and switch ports totaling under $1,000 are expected to sell at $500 in 1996. ATM NICs (Network Interface Cards) originally available at more than $4,000 in 1993 now sell for less than $1,000. There are, however, other economic factors.

Investing in ATM also involves expenditures for such essentials as cabling and switches. Jeffries (1995) noted that the price for ATM switches can range from $73,000 to $95,000. This figure does not reflect charges for such essentials as per-port price, ATM router interfaces, and equipment installation, maintenance, and support. Jeffries estimated that an ATM configuration can cost from $225,000 to $295,000. Steve Huber (personal communication, June 24, 1995), Manager of Advanced Technologies at Lockheed Martin Corporation, noted that the price of an ATM installation for a large company with four branch facilities nationwide is an estimated $245,000. Demand for ATM in a university environment will accelerate when this technology can bring real cost benefits and reliable performance to everyday network operations and specifications for ATM hardware and software are standardized and more clearly defined.

Tracking ATM

There is considerable excitement about ATM. Advances in this technology are occurring rapidly. Herman Hughes (personal communication, June 10, 1995), Professor of Computer Science at Michigan State University, predicts that an ATM infrastructure will be in place within the next three to five years. The projected full-scale implementation of ATM is generating a multiplicity of products and service providers and claims of hardware, software, and vendor superiority.

Jane Anne Hannigan (personal communication, May 20, 1995), Professor Emerita, Columbia University, advised: "Advances in this domain must be monitored so that we can develop reliable ATM solutions without being subjected to vendor pressures." Hannigan recommends creating an annotated file of information or "watching brief" that can be kept online. The Web is a rich source of ATM information. Technological developments are highlighted at such Web sites as *http://www.atm.forum.com/*.

Conclusion

ATM has emerged as an important technology for achieving an integrated networked environment. ATM can support innovative educational applications that reshape how future generations of students and instructors communicate, interact, and discover new knowledge domains.

Migration to ATM requires careful planning. Steve Huber (personal communication, March 15, 1995), observed: "The ATM field is changing rapidly. Those involved in the implementation process must be committed to continually modifying their strategies to reflect product and standard improvements without sacrificing the integrity of mission-critical goals and objectives."

By supporting reliable high speed, high performance transmission of multimedia applications to the desktop and in the wide area environment, ATM networks can lead to a revolution in teaching, learning, and research. An understanding of the capabilities, advantages, and drawbacks of ATM technology is critical in addressing challenges associated with the design and implementation of ATM networks for the distance education environment.

References

Jeffries, R. (1995, February). Building an ATM campus backbone. *Business Communications Review, 25,* 27–31.

Littman, M. K. (1996). Computer networks as facilitators for learning. In K. E. Vandergrift (Ed.), *Ways of knowing: Literature and the intellectual life of children* (pp. 137–184). Lanham, MD: Scarecrow.

Littman, M. K. (1995). New educational paradigms through ATM. In T. Sechrest, M. Thomas & N. Estes (Eds.), *Leadership for creating educational change. Volume 2* (pp. 689–691). Austin, TX: University of Texas.

McQuillan, J. (1995, April). ATM: year three—A report. *Business Communications Review, 25,* 10–12.

Nolle, T. (1995, June). Voice and ATM: Is anybody talking? *Business Communications Review, 25,* 43–49.

Patterson, J. S. & Smith, W. I. (1994, November/December). The North Carolina Information Highway. *IEEE Network: The Magazine of Computer Communications, 8,* 12–17.

Focus

Teaching, Learning, and Technology: Competencies for Preservice Teachers

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Key Words: **technology, competencies, preservice, teachers, computers, teaching**

Background

Rapidly changing technology has already had an irreversible effect on many aspects of our daily lives. Computer chips control our automobiles and household appliances. Telephone calls are routed instantly around the world by computerized switches. Retail sales clerks ring up sales using light pens and stationery bar code scanners. Plastic surgeons and orthodontists show clients computer images of the likely outcome of procedures under consideration.

Among the institutions last to be affected by technology is education. All major areas in society *except* education have wholeheartedly embraced technologies to help produce better outcomes while improving cost/benefit ratios. Education alone has had neither the clear incentives to change, nor the ability to fund the startup costs.

Of course, technologies are making their way into educational institutions in the US The federal Office of Technology Assessment (OTA) publication *Power On!* noted that most teachers *want* to use technologies, but graduates of teacher preparation programs feel ill-prepared to do so. For some years graduates of Northern Illinois University's teacher education program have consistently identified the lack of training in technology in their program of study as their biggest complaint about their education.

To address these matters, the Dean of the College appointed a committee to develop a plan for technology in teacher education. The committee was chaired by the College Technology Coordinator and consisted to two faculty members from each department in the college. Several goals became paramount.

First, we had to focus on ***competence*** with technologies of teaching and learning. Cognitive awareness or computer literacy assures neither the necessary skill nor motivation to adopt technological solutions to learning needs. Rather, teachers for the 21st century must demonstrate specific competencies concerning learning technologies.

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Second, delivery methods had to be ***flexible*** enough to accommodate widely varying backgrounds among students. Also, it could not be assumed that a new course would be mandated in the curriculum. The focus would be on competencies, not how they were gained.

Third, as rapidly as possible, the College should enhance the role of technologies within its programs beyond what is today's reality in the schools to the leading edge of learning technologies. Only then will our graduates be prepared to be ***leaders*** in educational change rather than followers.

Overview of the Plan

In order to infuse technology effectively into the teacher education curricula, the committee conceptualized a four-part plan called **Teaching, Learning and Technology** (TLT). Part One (Introduction to Technology Systems and Issues) and Part Two (Software and General Applications) are independent of specific curricula, but cover critical base knowledge and skills. Major courses may then build upon this base without devoting valuable time to basic technology instruction. Part Three (Teaching Strategies and Curriculum Applications) is directly linked to our majors and involves considerable faculty development. Part Four (Technology Planning and Evaluation) could culminate in some form of advanced certification by the college or a graduate degree.

Part One: Introduction to Technology Systems and Issues

Initial familiarity with and awareness of the range of possibilities and issues surrounding them is the starting point. This element of the plan introduces students to the technologies in schools, as well as those available but not yet widely adopted in education. The fundamental goal is to increase awareness of technology options, their potential applications in educational settings including schools and homes, and their ramifications. Content is organized under four headings (hardware, software, systems, and issues) and covers both Macintosh and *Windows* systems.

Part Two: Software and General Applications

Technology awareness is necessary but not sufficient in itself. Once students are familiar with systems concepts and terminology, the next step toward technological competence is development of essential skills in basic applications areas. The goal is to make teachers comfortable personally with a range of software applications that are useful in teaching and learning. The assumption is that one cannot and will not use technologies in teaching unless one has developed minimal competence in the operating fundamentals of each technology. This also provides the foundation for technology use within higher level courses specific to one's major. The goal is not "computer literacy" but "computer competence," the ability to use technology as readily and naturally as paper and pencil.

Seven application areas have been identified as basic for educators: word processing and publishing, software for managing learning, educational software, presentation graphics, databases, telecommunications, and spreadsheets. Goals and objectives for each of the seven areas are described in detail, along with general and specific competencies to be demonstrated by students.

Current Status

Implementation of Parts One and Two is underway as a voluntary program. Students are being informed throughout the College that the TLT plan exists and what its specifications are. They are invited to seek certification of their competencies by the

College through evaluation processes that measure the specified objectives. They are also given information about the available range of ways to gain knowledge that they may currently lack.

The College Technology Lab is the focal point for certification. Staff have developed evaluation materials for each area of competence and maintain a database of students who have satisfied the requirements. From the database, a certificate is issued to students, specifying the areas they have satisfied, whether only one or the entire TLT list. They are then encouraged to use their certificate as part of their placement credentials.

Implementation of Parts Three and Four is a longer range goal for the college, involving both faculty development (which is underway) and curriculum issues for a degree program.

Society

How to Do Successful Telecomputing Projects (ISTE SIG/Tel)

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Key Words: **telecommunications, distance learning, telecomputing activities, best practices, success indicators, ISTE**

Every year since 1991, ISTE's SIG/Telecommunications has conducted a juried contest to identify and recognize creative teachers who have pioneered the use of telecommunication networks to expand learning opportunities for their students. This Society Session features a panel of past SIG/Tel "telecomputing activity plan" contest winners. Their charge—to reflect upon the factors that made their projects a success—provides a jumping off point for exploring the many practical issues and strategies that must be addressed when developing and implementing a classroom-based telecomputing project or activity.

Here are some examples:

- Coming up with a good project idea
- Where and how to begin
- Developing a timeline and project structure
- Curriculum integration of the technology involved

- Student leadership and project management
- The teacher as project coordinator versus participant
- Keeping the interest level high
- Evaluation and documentation

Session leader Margaret Riel has spent much of the last decade conducting research and leading classroom-based telecomputing projects through the AT&T Learning Circle program and now the I*EARN project. Margaret serves on the SIG/Tel Board. SIG/Tel Board member Bill Burrall and other former contest winners offer their peers the nitty gritty details involved in using technology to integrate new and innovative instruction and learning into the curriculum.

> The enjoyable part was watching them take control of their own learning and education. As they worked on their projects on global peace, Gulf region politics, community profiles, textile industry, drug abuse, and self-reflective essays, I found their enthusiasm contagious. I found that I, too, was touched by the magic of being able to "talk" with my peers in distant places.
>
> —William Burrall, Moundsville Junior High School, West Virginia, USA

Enthusiastic comments like the above are often voiced by teachers and students as they participate in distance learning facilitated by computers and phone lines. But this excitement can be deceiving; it makes distance learning seem as easy as dialing a phone number. Even the most informal educational activity on a network represents many hours of planning and organization. When projects are well-planned, the results can be extremely impressive.

However, computer networking can also be a "black hole" into which one of our most valuable and limited educational resources vanishes leaving no discernible trace. That resource is teacher planning time. Teachers can spend countless hours either searching for projects that are appropriate for their students or in trying to organize projects of their own.

How can teachers avoid the black hole of networking and achieve the promise that advocates of computer networking describe with such missionary zeal? Here are some general recommendations.

- Find more than one or even two other classrooms to join in a project. Five to ten classes are optimal for most projects in order to maximize the diversity of students and the sharing of information across classrooms.
- Develop a well-defined group project that has a beginning and ending date and culminates in a written product; the final publication phase helps students reflect on their work and gives meaning to their exchanges along the way.
- Integrate the project within a larger framework of activities that take place in the classroom; for example, identify a part of the instructional unit that can be enriched by information from different locations.

From Promise to Practice

Computer networking is an exciting new tool for extending classroom learning into the community and utilizing peers around the world as teachers for one another The cost of telecomputing is very reasonable if it is used in ways that result in real gains in student learning.

Students are not the only learners in this new distant forum. When teachers work together to help each other extend classroom learning they benefit personally and professionally from these partnerships. Recognition for well-designed network lessons motivates teacher creativity. This type of collaborative work among teachers provides them a channel for the discussion of many issues related to school reform without leaving the classroom.

The infusion of new ideas and strategies from across a shrinking world is the promise of new communication technologies. Fulfilling the promise will require careful planning of this new educational context. The technical connections are a necessary but far from sufficient part of the process. The cost/benefit ratio is complex. The goal is to create an educational program using computer telecommunications that maximizes the educational benefit while minimizing cost in terms of our limited educational resources: teacher planning time; student class time, and, school funds. Good education is never free. But a range of different partnerships among software developers, communication providers, and schools are currently making it possible for teachers and students to connect their classrooms with new worlds of learning.

Society

Professional Development Online! (ISTE SIG/Tel)

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Key Words: **professional development, distance education, online learning, telecommunications, teacher education**

In a time of rapid technological change that is itself driving many of the movements for reform and restructuring in our schools, it is unfortunate that the use of telecommunication networks continues to be underused despite their potential as a medium to deliver instruction effectively and efficiently.

One factor consistently noted in research studies that document obstacles to the adoption of new technologies in schools has been the lack of training among teachers. ISTE and other education associations have worked to develop standards of technological literacy, but teacher training institutions have been slow to provide opportunities for new teachers to become familiar with the new tools and resources.

One positive trend that can help teachers become acquainted with new technologies is the use of professional development programs, both for inservice and preservice, that are conducted online in order to take advantage of the unique features of telecommunication networks. These new programs allow teachers to gain new skills, learn about new methodologies, and link up with colleagues and experts around the world while at the same time becoming familiar with the mechanical aspects of using the latest new technologies of online networks, the world wide web, computer-based word processing, access to databases, etc.

Telecommunication networks are changing the nature of teaching and learning. This panel session will explore a variety of professional development activities now available in the electronic environment. This new medium is being used to reduce isolation among teachers, promote interaction for cooperative activities, and to promote lifelong learning for teachers currently in our schools and for those about to join the profession.

Online professional development impacts many stakeholders: teacher educators and staff developers interested in taking advantage of online networks, teachers who need to develop new skills and learn about new methodologies, and administrators seeking information about how to provide learning opportunities for both faculty and staff. Significant issues that providers and educators must consider in constructing and offering professional development online include equity, access, and responsible use of electronic resources.

Many professional organizations have created an online presence so that educators can communicate with each other and with experts around topics specific to their particular field. Examples of these organizations include the National Education Association (NEA), Association for Supervision and Curriculum Development (ASCD), and the International Society for Technology in Education (ISTE). These organizations help support collaborative planning, access to organizational information, and forums in which questions and discussions can take place. In addition to national and international organizations, many state and regional networks have been developed for similar purposes. Examples include the Texas Educational Network (Tenet), which has created many discussion areas for Texas educators, and the School Study Council of Ohio, whose world wide web site is beginning to link approximately 80 member school districts, education agencies, and universities through inservice programs.

It is clear that the number and type of formal and informal courses currently being offered online is expanding with great rapidity. These have the potential to provide lifelong learning for all educators and learners. Entire degrees are now available online. There is no shortage of institutions eager to join this move to reach out and expand their student population base. A large number of individual courses are also available online. These represent a variety of formal, credit bearing courses—for example, standard undergraduate core courses, graduate courses in a variety of content areas, and informal courses.

Professional development courses are also available. ISTE has offered an online professional development course for educators around the world since 1990. The Online Internet Institute is a staff development model that involves short Face-to-Face meetings (one–three days) followed by extensive online support and home visits if necessary. Then, a 1.5 day FTF meeting covers topics that have surfaced during the online phase and includes planning for school year project work.

Educational opportunities also happen in more informal ways. Many people have taken the "Road Map to the Internet" mini course, which accrues no credit, costs nothing, and also provides little interaction with others. Its value is in serving precisely the task it sets out—to be a map for individual exploration and investigation. Commercial and non-commercial online networks for educators also provide informal discussion forums for educators, and many offer online conferences featuring guest experts and consultants who exchange views with participants. The Education Forum on CompuServe, for example, offers a futures forum that addresses school restructuring issues and new methodologies.

Focus
Alternative Voices on the World Wide Web

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Key Words: **Internet, mass media, alternative voices, World Wide Web, social studies, secondary**

The World Wide Web makes it possible for even relatively small nonprofit organizations and special interest groups to tell their stories online and reach a relatively wide audience. This healthy diversity of information sources and viewpoints represents an important resource for schools and libraries. Students need to be exposed to information that is often ignored by mainstream media in order to develop critical thinking skills and to gain a greater understanding of the complex issues and problems we face as a society.

Unfortunately, there are trends that make it more difficult for many communities to provide access to these "alternative voices." For example, concern over making the Internet safe for our children has led to the development of policies and even specialized software that limit or effectively censor access to areas that are judged to be controversial or inappropriate. In the US, the Telecommunications Reform Act of 1996 attempts to control the content of online discussions (e.g., open discussion of abortion issues) and to censor the use of language (e.g., forbidding the use of "swear" words).

In addition, commercial interests are rapidly learning how to exploit the potential of online communities as a new medium to reach their customers. Companies have rushed to establish a presence on World Wide Web servers, many investing large sums of money to develop lavish interactive environments to entice visitors. The commercial networks—AOL, CompuServe, Prodigy, et al.—have committed to full integration with the Internet and each has developed a strategy to place advertising at their most popular online gathering places.

These trends toward censorship, commercial advertising, and private sector domination of the Internet also occurred during the introduction of earlier mass media such as newspapers, magazines, radio, and television. Because it was expensive to create and distribute content or "programming" from centralized production facilities, it was necessary to choose between paying this cost through public funds or by allowing private sector companies to make the investment that would realize the potential of these new media. We chose the private sector, who soon discovered how to give away or distribute inexpensively their content and programming to the new mass audience by attracting a steady stream of revenue from commercial advertising.

It is appropriate for the K–12 education community to ask at this juncture whether the Internet is headed for a similar fate. Are we witnessing the birth of a new mass medium that will be used to further commercial interests and leave only minimal resources available for developing educational and cultural programs?

While the jury is out on this larger question, we can demonstrate today that for teachers and communities who are willing to make the effort, the Internet offers an opportunity to challenge students with alternative views of the world and options on the road to inventing our future. Many of these alternative voices online have developed supplementary curriculum materials and lesson plans that teachers can integrate in their classroom. These supplementary materials include both online projects as well as traditional print and audiovisual media that can be used offline.

Alternative voices address many different issues that are of particular interest to teachers at the middle school through high school levels:

- Environmental Issues—pollution, endangered species, nuclear power;
- Gender Issues—women's equity, sexual harassment, gay and lesbian lifestyles;
- Civil liberties—minority rights, ethnic discrimination, pornography, book censorship;
- Political views—libertarians, socialists, green party, Christian fundamentalists, etc.

The Institute for Global Communications (IGC), has been a leader in developing and supporting online networks all over the world who are organized to promote change and improve society at all levels. The I*EARN Project (International Education and Research Network) is notable for its commitment to telecommunication projects that link students and classrooms around the world with projects that "make a difference" by addressing real world problems and encouraging international understanding. A comprehensive listing of all organizations affiliated with IGC can be found at: *http://www.econet.apc.org/igc/orgdir.html*.

Essential Information (EI) "encourages citizens to become active and engaged in their communities, and provide provocative information to the public on important topics neglected by the mass media and policy makers." Participating organizations not only publish their investigative reports online, but they are staffed by personnel who are available to assist students who are seeking information for their own research. A brief sample of these organizations include:

- Congressional Accountability Project
- Center for Auto Safety
- Citizen's Clearinghouse for Hazardous Waste Council for Responsible Genetics
- Center for Science in the Public Interest Multinationals and Development Clearinghouse TV-Free America

In addition, many alternative voices can be found within the commercial online services. CompuServe, for example, offers interactive forum discussions on hundreds of specialized topics and attracts experts who exchange information with members. Students and teachers will find people with expertise on topics that range from vegetarianism and holistic health to New Age theories, parapsychology, and UFOs. In addition, CompuServe offers a wide variety of databases, including many that offer the full text of articles retrieved.

NECC participants who would like to obtain additional information and handouts may contact the author via e-mail.

Panel

The Role of the Internet in Teacher Education Programs

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Key Words: **Internet, teacher education, university, courses**

The role of the Internet in teacher education at two universities from diverse locations and different sizes will be presented and discussed.

St. Francis Xavier University is a small private university with a student enrollment of 3,100 located in Nova Scotia, Canada. This portion of the panel will discuss the Internet contents of the course taught by Dr. MacKinnon for education students. The presentation will include the use of e-mail, listservs, WWW browsers, the making of home pages for students and schools. This course is taught with extensive hands on computer usage. There is a class listserv and assignments and comments are sent to the class via the listserv and some assignments must be submitted by e-mail. Documents, significant reports and interesting resources are circulated to the class via the listserv by both the professor and the students. Class assignments include the selection and ratings of WWW sites and listservs in the subject of the teaching interest of the student. Students maintain a portfolio of all their Internet participation for the term. There are daily presentations by students of the interesting Internet educational resources they have found. Other aspects of the course will be discussed.

McNeese State University is a medium sized state university in Louisiana with an enrollment of 8, 500 students, approximately 25% of whom are enrolled in the education curriculum. Dr. Fisher will discuss the three-pronged approach employed at McNeese State University to promote (1) integration and application of the Internet into the graduate and undergraduate education courses offered by the Department of Administration and Supervision of the Burton College of Education; (2) training of a cadre of parish teachers in the use and application of the Internet in Teacher Education programs; (3) faculty professional development in the use of electronic telecommunication and the Internet. The presentation will include a discussion of the content of both the education courses and the faculty development program including access, materials, and assignments.

Project

Teaching Pascal Parameters: Revealing a Novice Misconception

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Key Words: computer programming, Pascal, parameter passing, modular programming

Background

Student interest in computer science and information systems, after reaching a peak in the early 1980s, has declined dramatically. When coupled with increased industry demand for information systems professionals and higher than average salaries, the decline is especially troublesome. Attrition in programming courses is especially high, and students, are often less than successful.

The literature confirms that many students find college-level computer programming courses demanding, and that attrition rates in those courses are high. Various authors offer reasons why students find programming courses difficult. In light of the preceding observations, it is not surprising that research reports of studies attempting to identify factors of computer programming success appear frequently. Although some studies have found positive correlations with computer programming ability, such studies generally are not very helpful to programming teachers. While background factors may assist advisors counseling students regarding the selection of programming classes, teachers cannot alter their students' age, gender, verbal ability, high school rank, cognitive style, or other background data. Programming instructors need research that informs the instructional and curricular decisions over which they have control. As understanding the programming language constructs is the first link in the cognitive chain of learning to program, it is not surprising that researchers have investigated various language constructs, attempting to describe expert and novice conceptions of those constructs. What is surprising is the virtual absence of attention to the construct of parameter or argument passing, the mechanism by which data are shared among the various program modules in a complex program. The topic is pivotal, since after the introduction of parameter passing in the introductory programming course, virtually every program the student encounters incorporates the construct. Moreover, many instructors and most students attest to the fact that parameter passing is the most challenging concept covered in the introductory programming course.

Current Study

The data for this project was drawn from a larger study of novice understanding of the parameter passing construct. Drawing from several methodologies traditionally employed in qualitative educational research, data sources included observation of the classroom instruction, semi-structured interviews, protocol analysis, and document examination. The bulk of the data was collected from eight students enrolled in one section of the introductory programming course at a regional midwestern university during a fall semester.

Linn and Songer's (1991) three-stage model for conceptual change—the stages being action knowledge, intuitive conceptions (more commonly known as misconceptions), and scientific principles—provided a conceptual framework for the study.

The larger study found that three students—two analytical learners and one concrete learner—exhibited problem-solving behaviors that could be attributed to a fundamental misconception of the parameter process. Errors they made supported an interpretation suggesting a systematic application of a parameter process that involved a direct procedure-to-procedure communication link. Consistent with the literature on misconceptions, some oral and written responses that initially appeared capricious, and even bizarre, proved to be logical and appropriate choices when interpreted in terms of the learners' hypothesized misconceptions. Moreover, students were able, despite their misconception, to construct modular programs that produced the correct answer by making seemingly innocuous adjustments to parameter lists, thus concealing the lack of understanding from the instructor and possibly from the students themselves. It is also important to note that, during the interviews, all three participants who seemed to foster significant misconceptions verbalized their inability to understand.

This session focuses on the question: What misconceptions do novices possess regarding the concept of Pascal parameters? It provides part of the answer by pursuing an in-depth analysis of one student's (Jason's) misconception.

A Capsule of Jason

At the semester's outset, Jason voiced confidence in his ultimate success in the programming course. Indicating that he had worked extensively with computer applications, he also reported having positive preconceptions regarding the course. Midway through the course, he identified what he liked best about the course:

> You have to do everything logically in order and steps and everything. Kind of everything you do in a program makes sense. Everything has its own little place and step, and has its own job to do in a program. It's kind of neat.

His observation about the best-liked facet of the course provides a clue to his analytical learning style, confirming a high score earned on a Piagetian inventory. Moreover, when asked which parameter instructional strategy had proved most helpful, Jason (in contrast to other participants who chose concrete examples such as the laboratory exercises or the simulation) alluded to the instructor's summation.

Jason was able to construct correctly working programs as long as he was allowed to use the same formal and actual parameter names, names that inevitably matched the variable names of the main module. Jason's reliance on parameter names that duplicated the main module's variable names camouflaged an important misconception. During a hand-construction task in which the parameter name choice was constrained, Jason failed to choose appropriate parameter names. This activity, along with other evidence, suggested that Jason imagined a direct procedure-to-procedure connection in which variable parameters with identical names provided the link. In harmony with his conception, Jason appeared to have expunged the role of the actual parameter list in the parameter passing process.

Summary

The project will feature the problem-solving activities that provided the evidence for Jason's hypothesized misconception. Additionally, it will include a laboratory activity designed to force students to confront a misconception such as that attributed to Jason, perhaps enabling some students to move beyond a stage of intuitive conception to a stage of principled understanding of the parameter process.

Reference

Linn, M. C. & Songer, N. B. (1991). Cognitive and conceptual change during adolescence. American Journal of Education, 99, 379–417.

Project
Taking a Byte Out of Technology

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Key Words: **staff development, training, distance education, televised instruction, technology integration**

A collaborative effort between Lubbock Christian University (LCU), Texas Education Service Center (ESC) #17, the Panhandle-South Plains Center for Professional Development and Technology, and the Lubbock Independent School District produced a 30-hour technology staff development course titled Take a Byte out of Technology on LISD-TV during July, 1995. An additional feature of the project was a study to determine teacher's attitudes before and after this type of professional development.

The goal of the course was to familiarize teachers with *ClarisWorks*, *HyperStudio*, and telecommunications on the Macintosh. Also included each day were ideas for enhancing instruction with technology, interviews with teachers using technology, and general technology information such as troubleshooting, use of satellite/cable TV in the classroom, ESC resources, etc. Participants worked on computers at home or at LCU to complete assignments made during the televised portion of the course. Opportunities to interact with various instructors were provided by phone, fax, or electronic mail. A viewing room at ESC #17 was provided for teachers who did not have access to cable TV and a computer lab at LCU was provided for those who did not have a computer at home. Participants employed by LISD were encouraged to take computers home from their schools during the summer.

The course consisted of ten two-hour sessions broadcast on LISD-TV from July 17–28, 1995. Thus, the 30-hour course consisted of 20 hours of instruction and ten hours of credit for doing the assignments. A typical two-hour session included 30-minute instructional segments on telecommunications, *ClarisWorks*, and *HyperStudio*. The remaining 30 minutes was dispersed throughout the program and included opening remarks, interviews, general technology information, drawings for prizes, transitions, and closing remarks.

The focus of the quantitative study for this project was on the dependent variables of innovativeness and locus of control and independent variables of attitude and self-efficacy of participants. Participants completed pre and post workshop instruments. Quantitative data is still be deciphered. Early results indicate a relationship might exist between locus of control and attitudes of the participants. Qualitative research also yielded results from informal questions, oral student feedback, daily assignments, e-mail, *HyperStudio* projects, live call-ins, and unsolicited feedback.

Comments from participants after the course were generally positive. They particularly enjoyed being able to take the course at home. Another positive aspect was the number of community people who also watched the show. Consequently, a new weekly show on LISD-TV titled *Take a Byte* emerged that demonstrates all types of instructional technology and discusses current technology news and information.

Project
Envision It!: Teaching Teachers to be Computational Scientists

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Key Words: computational science, simulation, modeling, visualization, K–12 education, mathematics, science

Project

Envision It! is a teacher enhancement program designed to introduce secondary math, science, and technology teachers to classroom applications of computational science. The *Envision It!* approach is to use modeling, simulation, and visualization tools available for Macintosh and PC desktop computers as the entrée to computational science, with access to high performance workstations and/or supercomputers reserved for later stages of the teachers' training. Application software such as Matlab, Stella, and NIH Image offer the novice the chance to learn and practice the concepts and skills of computational science without needing to learn an advanced programming language. Additionally, schools are more likely to have the resources for teachers and students to use these tools in the classroom.

Participants

Envision It! is for teachers of grades 8–12 math, science, and technology. Three and four-person interdisciplinary teams of teachers from the St. Paul-Minneapolis Metropolitan Area of Minnesota are accepted. Currently in the project, we have teams from the following schools: Anoka H.S., Coon Rapids H.S., Hastings H.S., Highview Alternative, Johnson H.S., Mpls. South H.S., Minnetonka M.S., St. Louis Park J.H., St. Paul Central H.S., and Shakopee H.S.

Training Format

One cadre of 32 teachers is currently engaged in an 18-month training program beginning with a three-week summer institute, followed by four one or two-day follow-up and networking sessions throughout the school year, and a final three-week summer institute. A second cadre of up to 36 teachers will begin a similar journey starting in summer of 1996.

Timeline

Summer training for Cadre I is July 22–August 9, 1996

Summer training for Cadre II is July 8–26, 1996

Summer training for Cadre II is July 14–August 1, 1997

Project close is March 1998

Teacher Benefits

- Software to make modeling, simulation, and visualization possible
- Stipends for summer and evening sessions
- University of Minnesota graduate credit
- Training in the tools and skills of computational science
- Training on Internet
- Time for practicing skills and planning learning activities
- Experience with supercomputers, workstations, and personal computers
- Ongoing technical support
- Ongoing peer support
- Relationships with businesses and researchers using computational science

Expectations of Participants

- Attend training and follow-up sessions provided
- Work as interdisciplinary teams
- Create interdisciplinary instructional modules using computational science to teach current topics in math and science
- Network electronically with others interested in computational science and education
- Train other teachers in the uses of computational science in the secondary classroom

Project Partners

Envision It! is directed by the Educational Cooperative Service Unit (ECSU) of the Metropolitan Twin Cities Area and funded by a three-year grant from the National Science Foundation (Grant No. ESI-9453913). Partners in the project are: Anoka-Hennepin School District, Cray Research, Inc., and TIES (Technology and Information Educational Services).

For further information, see: http://www.cray.com/envision

Focus

Virtual Realities and the Future of Text

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Key Words: **virtual reality, interface, future**

> "Suddenly I don't have a body anymore. At least I know where I left it. It's in a room in a building in a town in California. But I—or "I"—am in cyberspace, a universe churned up from computer code, then fed into my eyes by a set of goggles through whose twin videoscreens I see this new world. All that remains of my corporeal self is a glowing, golden hand floating before me like Macbeth's dagger. I point my finger and drift down its length to the bookshelf on the office wall ...."
>
> —John Perry Barlow

Forward to the Basics

At various laboratories and art installations around the country, and in some malls and video arcades, you can now enter worlds that resemble the ones you're generally familiar with, but in which the laws of the universe are sometimes modified or eliminated. To do this, you typically wear special headgear that tracks head movements and provides a three-dimensional image (a kind of Walkman for the eyes). There is also a glove or other device that tracks the position and configuration of your hand. Both pieces of apparatus are connected to a computer that provides the visual displays and responds to your head and hand movements (and sometimes provides sounds, pressure, and resistance to movement).

These technologies are used to create a "virtual reality," a simulation that you seem to enter physically. It's a kind of "deep medium." Randall Walser, of the AutoDesk Research Lab, suggests that if text "*tells*, and video and film *show*, then a virtual reality *embodies* the world it creates." Virtual realities dissolve the line between the interface and the *innerface* of the worlds you wish to explore.

John Perry Barlow, who's experience with the AutoDesk system introduces this discussion, tries to "grab a book, but my hand passes through it." After some guidance, he succeeds: "When I move my hand again the book remains embedded in it. I open my hand and withdraw it. The book remains suspended above the shelf." Since the only part of himself he sees in this new world is "a glowing, golden hand," he realizes that he doesn't "seem to have a location exactly. In this pulsating new landscape, I've been reduced to a point of view. The whole subject of 'me' yawns into a chasm of interesting questions."

In a very different setup, David Rokeby's "A Very Nervous System," your body's movements (with no glove or goggles) are tracked by video cameras and translated into music. Space itself is now the interface between you and the computer; space has become a medium in itself. People who have experienced this sort of environment sometimes note that the relationship between cause and effect seems to disappear. Rob Appleford, for example, noted that, "[As I walked back to the university] a truck splashed through a puddle, and I caught myself trying to make that neat noise again by retracing my steps."

With a related kind of system, "Mandala," from Vivid Effects, you stand in front of a video camera with a blank background behind you. Your image is transferred into a computer screen that has special images on it (e.g., musical instruments, floating alphabet letters, or a hockey rink). As you move in front of the camera, your image on the screen can interact with the objects there: playing the instruments, grabbing letters to form words, blocking shots. You (or is it your image?) have become a virtual icon, interacting with other icons on the screen.

A different goal is being addressed by the MCC consortium in Texas, where they're developing ways to represent large and complex bodies of knowledge in a computer-generated virtual space. In this case, navigating through a body of knowledge involves being able to yaw, pitch, and roll as if you were flying a helicopter, a rather different set of skills than knowing how to turn pages or to use an index or table of contents.

Closer to Home

It's hard to communicate, in print, the look and feel of entering virtual worlds. (Can you easily describe to a non-reader what it feels like to be "lost in a good book"?) Having tried, however, to make strange things familiar, it might be instructive at this point to make some familiar things strange.

Consider this. Text simulates thought. It's an artifact, representing with its own particular richness and its own unique limitations the ineffably complex workings of the human mind going about its business of making sense of things. Text is a *version* of the thought that the text represents. It's a working model of what's on our minds. As with other kinds of simulations, we can interact with and affect text (aka reading and writing). Text is virtual thought.

We've long since become accustomed to a range of materials that embody text, paper being the predominant one (which some people, interestingly, equate with being "carved in stone").

Now consider this. A word processor creates virtual paper. The technology, in fact, fills a new medium with an old content. We tend to think of a word processor as a kind of way-station on the way to a printout, "hard copy." We imagine there's a sort of paper scroll moving past the "window" of the monitor screen. This simulated paper has, however, powers and abilities far beyond those of normal paper. The "videotext" sometimes blinks, ripples, and slides. It can disappear and reappear. It can change its shape and sometimes its color. It can have embedded in it "buttons" (and I am talking about word processors here) that will play sounds and recorded voices or show moving pictures. This sort of virtual paper is less and less designed to be "printed out" (although more and more we're hearing the phrase, "print to video"). Increasingly, this sort of document's home is in the computer environment in which it was created.

Many people's thinking includes pictures and sounds as well as words—unless, like Einstein, you also think in colored patterns and muscle sensations (contrary to my high school English teacher's dictum that "if you can't put it into words, you can't be thinking it"). Thus, these kinds of technology-enabled multimedia and "hypermedia" environments, ones that allow a variety of "documents" to be stored, linked, intermixed, displayed, and altered by the "writer" and "reader," are steps toward the creation of virtual texts.

And Down the Road

There are, to be sure, examples of "virtual books" that are currently available commercially. The illustrated children's stories in the Discis collection, on CD ROM discs, will read themselves to you in English or Spanish, in word or phrase groupings of your choice. They will provide you with definitions of each word and will remember the words you didn't know. You can have the books instantly "rewritten" in different typographies. The recently released Expanded Books, from the Voyager company, provide moving images and sounds to accompany the text, along with special text-searching and annotating features. The "books" are stored on computer disk, for use with Apple Computer's PowerBook series of computers.

These two examples illustrate small, carefully designed steps toward the development of virtual books and writing implements. Combined with the more thought-provoking examples above, they suggest that we can begin to ask a new set of design questions regarding future reading and writing environments.

What should a "smart book" do? Learn your reading level and adjust itself accordingly? Shouldn't your word processor learn your writing style and bring into play a set of tools adjusted to your habits and needs? (In point of fact, four major software publishers have announced development plans along these lines.) How do you turn the page of a virtual book? With a wave of your hand? Does it even have pages? Can the notion of a book, set in type, with a fixed point of view, be expanded to include a more fluid entity, one that is shaped by each reader, with the construction of meaning derived from conscious and explicit interactions between the text, the reader, and previous readers who have become contributing authors? What about sound tracks for books?

Akram Midani, Dean of Fine Arts at Carnegie-Mellon University, notes that our involvement with new technologies generally moves from an ambivalent relationship with augmented abilities to the "dawning of irreversible change." Think of word processing in this regard. In the teaching of writing, there are still wide-spread uncertainties about its value, its effects on writing, the manner in which it should be taught, and the ancillary computer-based tools that should be used in conjunction with it (prewriting software, spelling and style checkers, keyboarding tutorials). Yet, are there many people who regularly use a word processor who would willingly give it up?

Virtual realities provide a very curious set of technologies, ones that have implications for the basic tools and substance of our work. Barlow, quoted above, felt himself to be a "traveler in a realm what will ultimately be bounded only by human imagination." At this point, the territory of virtual realities is a kind of unreal estate. Nevertheless, those who are exploring it are already helping expand and enrich our expectations and visions for integrating technology into reading and writing.

References

AutoDesk Research Lab, AutoDesk, Inc., 2320 Marinship Way, Sausilito, CA 94965.

John Perry Barlow. "Being in Nothingness," *MicroTimes*, January 22, 1990, pp 96ff.

Discis Books. Discis Knowledge Research, Inc., 45 Sheppard Ave., East, Suite 410, Toronto, Ontario, Canada M2N 5W9.

Expanded Books. The Voyager Company, 1351 Pacific Coast Highway, Santa Monica, CA 90401.

Mandala. Vivid Effects, 317 Adelaide St., W. #302, Toronto, Ontario, M5V 1P9, Canada.

Reality Built for Two; the DataGlove. VPL Research, Inc., 656 Bair Island Road, Suite 304, Redwood City, CA 94063.

SemNet. Microelectronics and Computer Corporation, PO Box 200195, Austin, TX 78720.

A Very Nervous System. David Rokeby, 349a Spadina Avenue, Toronto, Ontario M5T 2G3, Canada.

Project

Eatontown Schools' Secrets for Technology Literacy Implementation K–8

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Key Words: **mentoring, curriculum integration, practical applications, implementation, rubrics**

Eatontown's staff and students have discovered a very easy, enjoyable method of developing literacy in their well-equipped Eatontown schools—mentoring.

Administrators, teachers, and students work as mentors to guide each other through this maze of technological wizardry. This has given excitement and ownership to their technology program.

Eatontown Schools have used mentoring to create an environment which enables teachers and students to gather, explore, learn, manipulate, and share information using technology in all curriculum areas—not a transference of information from teachers to students.

Students in kindergarten through eighth grade have been afforded the opportunity to have the use of Mac computers, inkjet and laser printers, LCD panels, CD-ROMs, LaserDiscs, and digital cameras in their classrooms and labs. Subsequently, a wonderful wave of cooperative learning has spread throughout the entire school district!

There is no longer a separate Computer Literacy Curriculum—there is no "computer teacher." Each curriculum guide now has its own technology section. Computer literacy is being taught through practical applications, and technological tools are used as needed in the educational process—whether it be math, science, reading, music, art, social studies, etc. The students and the teachers have made tremendous progress in developing their level of computer literacy, proficiency, and comfort.

They have incorporated technology into the existing curricula as an instructional and communication tool to enhance and support instruction, learning strategies, and critical thinking skills.

Authoring and desktop publishing have flourished in classrooms and labs. All students have improved their communication skills—from the youngest kindergartners, writing and publishing their own books to sophisticated eighth graders, producing quality research papers for their science fair and English projects!

The district is providing teachers and students with technological tools for tomorrow. Therefore, they will continue to use the educational process to drive technology and not let technology drive the educational process.

This project shares strategies for planning, implementing, and nurturing a successful technology program noted for student enthusiasm and commitment:

- How to begin a technology literacy program
- How to choose suitable software to meet the students' needs, the special needs of curriculum projects, and the budget
- How to use software effectively with students and help them gain confidence in their technology skills
- How to foster responsible computer behavior
- How to develop good publishing skills based on rubrics developed to meet the needs of the curriculum

Focus
Multimedia Makes Curriculum Come Alive

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Key Words: **multimedia, presentation software, rubrics, digital cameras, interdisciplinary**

Suzanne Flannelly, Dotte Marshall, and Agnes Zaorski began sharing multimedia ideas while serving on the executive board of the Monmouth Technology in Education Council.

These panel members will present ideas for enabling students in kindergarten through eighth grade to learn to use the computers as a tool to explore multimedia. Through a variety of sample student projects, panelists will demonstrate the planning, implementation, evaluation, and nurturing strategies that they use in their schools. These strategies teach their students to transform large quantities of curriculum information into usable knowledge geared to their abilities and interests.

Successful student projects have verified the supposition that multimedia is a powerful tool in the hands of students. Rubrics make all the difference. Guided by projects' rubrics, the students are empowered to creatively accomplish the goals of their projects within this framework.

Gathering
Exploring
Manipulating
Producing
Communicating information

The panel will discuss the creation of multimedia presentations that take advantage of the unique features of *ClarisWorks, Adobe Persuasion, Digital Chisel, HyperStudio, HyperCard, LinkWay, Kid Pix,* and *Claris Impact* to generate audience enthusiasm and involvement in technology presentations. Appropriate techniques for both simple and elaborate presentations will be explored through student and teacher projects.

Paper

Problem Solving About Problem Solving: Framing a Research Agenda

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> "Those unable to use ... (technology) face a lifetime of menial work."
> *What Work Requires of Schools: A SCANS Report for America 2000,* p. 15

"Despite technologies available in schools, a substantial number of teachers report little or no use of computers for instruction. Their use of other technologies varies considerably." *Teachers and Technology: Making the Connection*, p. 1

"The challenge of integrating technology into schools is much more human than it is technological." *Using Technology to Support Educational Reform*, p. 83

Key Words: **research, problem solving, teacher training**

Abstract

Government agencies, corporate executives, educational policy makers, and futurists tell us that solving novel problems, using computers as tools for thinking, and developing flexibility of thought and action will be key requirements in the next century. But available data about students' problem solving show disappointing results. In order to provide teachers with support for the improvement of computer-based problem solving we need to ask a series of questions—and provide answers—about how to teach problem solving to students and how to design training courses for teachers so they will incorporate those strategies into their day-to-day teaching.

Introduction

For all the early promise of technology, educators seem to be using technology to do what they used to do with textbooks rather than reframing education to fit what technology can do. The promise of computers as tools for problem solving, in particular, seems to have evaporated. I can remember when educators were excited about computers. "Recursion will allow us to show students what recursion is and let them play with it," they said. "Visual hands-on approaches to geometry can happen quickly, intuitively, and easily," they declared. "At last we can bring inference, and statistics, and probability into the curriculum as we never could before."

Problem solving, a topic that many professional groups and curriculum development specialists had agreed was difficult to teach with textbooks, was viewed as an excellent candidate for increased attention in the computer age. Problem solving had long been identified as a weak spot in American education. American students did not score well on various rounds of the National Assessment of Educational Progress testing program, nor did they show themselves to good advantage when compared with students in other countries. Problem solving as defined by Polya (1973) and not as defined by the standardized tests administered to American school children—which are simply measures of how many word problems can be solved correctly—was viewed as an important component of the mathematics curriculum, but one which was difficult to operationalize within the confines of the traditional textbook-driven curriculum. So technology was greeted with acclaim by many educators intent on improving the quality and quantity of problem solving in American classrooms.

Business (1991) has told us that problem solving—the ability to deal effectively with novel situations and create flexible, workable, elegant solutions—is a key component in maintaining our country's competitiveness. It has been agreed that tomorrow's work force needs to know more than which keys to press for which hamburger order, and that the Workforce 2000 and beyond needs to use technology as part of a general problem-solving process. So more than a decade after the introduction of computers into the schools where do we stand?

Surveys of computer use have shown us that problem solving via computer hasn't been widely accomplished (Anderson, 1993). To be sure, there have been exciting developments—many of them chronicled in the OTA report *Teachers and Technology: Making the Connection* (1995). But those developments have been isolated—occurring in only a few schools or universities, and not on a systematic basis. According to the OTA report, teacher education programs seem slow to incorporate models of good technology practice into their classrooms. The OTA report also says today's teachers, in large measure, have ignored the technology revolution or have incorporated a few bits of technology here and there, but by-passed many significant developments such as geometry programs where students can actively explore their questions about relationships between lines and angles, or where students can be confronted with novel logic problems and work toward the solution of problems that call for more than mere computational competency.

"There is no good software out there," had been a long-time defense against problem solving via computers. But professional groups have issued lists of software deemed noteworthy. It isn't necessary for teachers to sift through mountains of poor software packages to find one or two that may work in their classrooms.

"There are not enough computers," had also been a long time defense. But recent data (OTA, 1995) show that computer-to-student ratios are getting better all the time. Yes, some of the computers are 8 bit machines but one can still do worthwhile problem solving with 8 bit machines, and a judicious re-allocation of machines around the school system will certainly yield computer configurations to address many different types of needs (Marshall 1993a).

The issue, whether we like it or not, is primarily based on human perceptions, attitudes, and intentions as Means (1993) pointed out. These issues will not be resolved by purchasing additional computers or providing new and different software. Nor will they be solved by providing training—just any type of training under just any type of conditions. We need data, not declarations about the need for teacher training. We need models of what works, not mandates for more training.

Good data tell us what happened, why it happened, the conditions under which it happened, and what didn't happen and why. Many teachers are afraid to devote time to problem solving because they're not sure about the benefit to their students since research on problem solving often suggests that computer-based problem solving has no effect on students. So we need to know how good instruction does produce results.

Many research studies have been compromised by poor designs, inappropriate measures, and faulty assumptions. For example, Charters and Jones (1973) offered several conditions that educational research must meet: Researchers must ask the right questions and they must ask enough questions to describe the situation; researchers must make sure that if control groups are used the students in both groups really are similar, and that teachers or "the treatment" are described properly when comparison studies are conducted; researchers must make sure that "the treatment" was actually implemented and implemented in ways described by the project designers. If not, they must detail where the differences occurred and what contributed to those differences.

But research in computer use has failed to follow the wisdom of Charters and Jones's suggestions. We are rich in survey data—"How many computers are used and for what subject areas?" (Becker, 1983). We have responses and analysis of questionnaire data—"How has using computers changed the way you teach?" (Hadley and Sheingold, 1993). We have learned about innovative ways to deliver training, but we have no idea how different strategies for training can and do produce intended results.

Before we begin to design and deliver large-scale training (if indeed, the money ever becomes available), we need to answer some fundamental questions. Since computer-based problem solving was viewed as an important educational step forward, but seems to have been avoided by many technology-using teachers, asking questions about problem solving is a good place to start a rigorous examination of what's happening and why in technology-equipped classrooms.

While work on a research agenda has been initiated within the International Society for Technology in Education (ISTE) (Roblyer, Smith and Robin, 1995), the work fails to acknowledge such key issues as the epistemological assumptions of the researchers or teachers and ignores many important issues at the classroom level, so this paper seeks to continue and amplify the discussion about research, its aims and operations.

Research Questions About Problem Solving

Research Question #1

What are the teachers' and researchers' assumptions about the relation between teaching and learning?

For a long time, the behaviorist paradigm has dominated education in general and educational research in particular. We must acknowledge that good problem-solving instruction won't fit the behaviorist mode of teaching and many traditional types of pre-/post-studies are not robust enough to capture the effects of good problem-solving instruction; nor are the measures used sufficient enough to capture the effects of good practice (Marshall, 1993b). Research studies are needed that fully describe the different types of problem-solving lessons, the extent to which the teachers followed the goals of the software, and the types of thinking strategies students practiced and applied.

Research Question #2

What constitutes "good teaching" in technology-based classrooms where problem solving is a goal and what do "good" teachers do that their colleagues don't do?

First of all, let's acknowledge that we have only sketchy criteria for what constitutes good teaching in computer settings, especially when it comes to problem solving. Responses to surveys that tell us how satisfied teachers are or how dissatisfied they are with what they're doing (Hadley and Sheingold, 1993). We also have *Guidelines for Good Practice* (1991), but have we communicated what a "good lesson" looks like? Do teachers know what good technology-based problem solving looks like? Is it different from work with manipulatives used alone, or with activity books and textbooks? Do we know what practices lead to what results in children's thinking as a result of interactions with technology? To date, answers to these questions are sketchy at best.

Research Question #3

What is the relation, if any, between "good teaching" and students' ability to problem solve successfully?

Models exist for "good" lessons. For example, a "good" week in a math class is supposed to consist of the teacher modeling the application of a new algorithm on Monday, calling students to the board on Tuesday to work on variations of the problems, providing time for seat-work in textbooks and workbooks on Wednesday and Thursday, and then testing students on Friday. Is that a good model for problem solving? If not, what do good problem-solving lessons look like? How do we know if those models work? Do those models have differential effects on students?

Research Question #4

How have schools or school systems successfully overcome teachers' resistance to using technology and how successfully have those teachers been trained?

Teachers have developed a resistance to change. Some believe that technology is a fad that will go away. Given the revolving door nature of most educational innovations in the USA, their beliefs seem reasonable. Teachers have become weary about investing their energies in efforts that will disappear when the superintendent leaves for another school district. Do we know how to move resistant teachers to becoming computer-using teachers? Do we know how to help teachers who use computers for nothing but word processing move toward integrating problem solving into their technology routines?

Research Question #5

What results, in terms of student learning, have accrued from change strategies directed at increasing or improving the teaching of problem solving?

Training is as training does. For years we have been hearing that training is a key element in converting the technology-avoider into the technology-user. But 15 years into the technology revolution, we don't have a clear set of guidelines about what types of training bring about what types of change in teachers and even less evidence of the impact on students of our interventions. We have anecdotal evidence about programs that bring teachers into the technology fold, but we have no data on the effectiveness of that training on the newly-trained teacher's ability to (1) implement what has been presented, (2) implement it in a sustained way and a way that's faithful to the intent of the developers of the programs and the goals of the workshop presenters, and (3) positively affect student outcomes as a result of that change.

Research Question #6

What types of training for what duration and with what frequency with what types of teachers—veteran teachers, new teachers, teachers who believe in "hands-on" and teachers who "go by the book"—produce "good teaching?"

Does having a fellow teacher team teach with technology promote better results than "pull out" training? Is the cost of training a major variable? Does training before the school year begins have more impact than school-year wide training? What types of teachers—new-to-teaching or veterans, behaviorists, or constructivists—profit from what kinds of teacher training models?

Do we even know what questions to ask about training? We have little or no data on how much of what has been presented in training is actually used in classrooms—and what data we have tends to be from small samples or unrepresentative samples. We have little or no data on how long newly-trained teachers actually implement the changes they've seen. We do have evidence (Marshall, 1996) that some trainers fail to understand the software packages they themselves are using in training situations.

We need more information on the specific features of training programs that produce reproducible results. Good faith and good intentions are insufficient when we consider the demands for good practice. We need systematic evidence of what is necessary and what is sufficient in training situations.

Research Question #7

How do different training strategies produce positive changes in students' problem-solving behavior?

What "we, the trainers" know is not what "you, the teachers" value. Let's be clear at the outset. Data show us that mathematics is taught for less than 20 minutes a day in some classrooms and that computation lessons—primarily "seatwork"—dominate the instructional plan. Lessons devoted to skills recommended by professional organizations (1989)—geometry, probability and statistics, logic—are seldom, if ever taught. Textbooks still tend to treat these topics, if at all, by including chapters at the back of the book—a clear signal that teachers can take it or leave it. Now maybe this pattern of computational dominance is rooted in the fact that teachers haven't been adequately trained to do more than computation. But we need to know if these issues are implicated in our students' failure to problem solve successfully.

Teachers teach what they believe in or what their communities value. Computation is still highly valued as a skill, and many teachers and parents believe that computation—the "one right way and one right answer" approach—is the only appropriate subject matter, especially at the elementary school level. Take 20 minutes per day for instruction, do a little computation, and there's not much time left over for other mathematical activities. Do these practices compromise students' ability to problem solve? If so, how do we encourage teachers to teach beyond computation and, in the process, enhance students' problem-solving abilities?

Research Question #8

What different types of training strategies need to be employed to deal with differences in teachers' beliefs about what should be taught and how it should be taught?

Some teachers are firm believers in a behaviorist approach to teaching and learning. For many of them, problem solving instruction, at least in the elementary schools, is not an appropriate use of students' time. Other teachers say teaching problem solving will have little effect on students' performance on standardized tests—the benchmark against which many instructional activities are weighed. How do we promote an acceptance of problem solving in those classrooms? And does that acceptance translate into improved problem solving ability for our students?

Research Question #9

What types of training are needed to provide teachers with both the mathematical knowledge necessary to conduct problem-solving lessons and the pedagogical skill to use technology for those lessons?

Once there was a "cottage industry" approach where software developers who thought they had important ideas that had not been addressed in textbooks developed interesting ways to present those ideas via technology. But we often found that the topics introduced were new to many teachers and frightening to some because their own educational experiences in mathematics had not been rich enough to give them a foundation in a broad range of mathematical topics.

Today we have the increasing presence of large-scale producers of Integrated Learning Systems (ILSs) that tend to present computationally-based activities to the exclusion of problem-solving activities. At this time many believe that the ILS producers will eventually dominate the market to a greater extent than they do today. Some would say that to invest time and energy in learning problem solving and learning to teach problem solving, is a waste of time because in practice schools will ignore the demands of business leaders and government officials and follow the lead of the ILS producers. How do we help teachers acquire expertise in selecting topics and delivering lessons based on good problem solving of their own design instead of relying on ILSs?

Research Question #10

What differences, if any, are there in the outcomes in students' learning to be problem solvers when computation is the sole or major focus of computer use versus experience with problem solving software, and does ILS use contribute to or detract from problem-solving expertise?

We have no idea how much exposure to computers and in what pattern—ten minutes every day, half an hour every few days, a hour a week, none of the above—produces consistent lasting effects of instruction. We don't know if computer use needs to be buttressed with complementary work with manipulatives—and, if so, at what grade levels that use is needed—or supplemented by films, books, field trips, etc. We need to design studies that explore how students learn problem solving via computer.

Research Question #11

What role does the choice of measures play in our efforts to learn about the impact of technology on students' performance?

"Why should I teach it when they don't test it?" This question has challenged innovators designing problem-solving curricula for over 30 years. Many curriculum development projects that received massive infusions of federal dollars were stymied when school systems demanded hard data to show that students taught problem solving were performing better than their peers who were doing their multiplication tables every day (Marshall, 1994). The problem faced by the curriculum developers had several facets: schools tend to trust the standardized tests currently used by most school systems in the US and only those standardized tests; those standardized tests have a sub-test called "problem solving" but the sub-test merely tests students' ability to solve word problems. The tests are not sensitive enough to detect differences in overall mathematical ability acquired from problem-solving curricula. As a result, many of the projects were deemed to have failed because students' scores in "problem solving" did not rise sufficiently to justify the school systems' continuance of a problem-solving approach.

The fact that other measures were and are available—all standardized, all subjected to appropriate methodological practices—did not deter schools and school systems from relying only on "traditional" tests. The fact that other measures could be statistically equated with traditional tests so we could have indices of both "traditional" test performance and problem solving performance has been ignored or avoided by school system decision-makers.

Until we answer these questions and other questions aimed at teasing out the multiple, and often competing, factors at work in the design of evaluations, in the implementation of technology, in the training of teachers, and the assessment of students our efforts at training teachers to use technology's full potential in order to equip students for 2000 and beyond will be stymied.

References

Anderson, R. (1993). *Computers in American Schools 1992: An Overview.* Minneapolis, MN: University of Minnesota.

Becker, H. (April, 1983). *School Uses of Microcomputers.* Center for Social Organization of Schools. Baltimore, MD: The Johns Hopkins University.

Charters, W. W. & Jones, J. (1973). On the risk of appraising non-events in program evaluation. *Educational Researcher 2,* 11.

Hadley, M. & Sheingold, K. (1993). Commonalties and distinctive patterns in teachers' integration of computers. *American Journal of Education 101*, 261–315.

Marshall, G. (1993a). New uses for old computers. *The Executive Educator 15* 11–12.

Marshall, G. (1993b). Informatics and changes in learning: The American dilemma—opposing epistemological perspectives and unanswered questions. *Informatics and Changes in Learning*. D. C. Johnson and B. Samways. (Editors). Amsterdam: Elsevier Science Publishers, 203–210.

Marshall, G. (1994). Cautionary verses: Prospects and problems in achieving the aims of the computer revolution. *Exploring a New Partnership: Children, Teachers and Technology*. J. Wright and D. Benzie. (Editors). Amsterdam: Elsevier Science Publishers, 9–19.

Marshall, G. (1995). *The ABCs of Today's Technology Decision-making in Australia, the United Kingdom, and the United States*. A paper presented at the 6th IFIP World Conference on Computers in Education. Birmingham, UK.

Marshall, G. (1996). *Time for Change: Critical Issues for Teacher Education*. Unpublished paper submitted to the IFIP Working Conference, Israel.

Means, B. et. al. (September, 1993). *Using Technology to Support Education Reform, OR-93-3231*. Washington DC: U. S. Department of Education, Office of Research.

NCTM. (1989). *Curriculum and Evaluation Standards for School Mathematics*. NCTM: Reston, VA.

Polya, G. (1973). *How To Solve It*. Princeton, NJ: Princeton University Press.

Roblyer, M., Smith, R., & Robin, B. (1995). A research agenda for topics and methods in educational technology identified by technology-using educators. *NECC '95 Proceedings*. Baltimore, MD, 80.

Secretary's Commission on Achieving Necessary Skills. (1991). *What Work Requires of Schools: A SCANS Report for America 2000*. Washington DC: US Department of Labor.

Taylor, H., Aiken, R. & van Weert, T. (1991). *Informatics Education in Secondary Schools. IFIP Working Group 3.1 Guidelines for Good Practice*.

U. S. Congress, Office of Technology Assessment. (1995). *Teachers and Technology: Making the Connection, OTA-EHR-616*. Washington DC: US Government Printing Office.

Society

Implementing the Tenth Strand: Extending the Curriculum Requirements for Computer Science (ACM SIGCAS)

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Key Words: **ethics, computer science, curriculum development, computers and society, Project ImpactCS**

The first report of Project ImpactCS provided a formal, theoretical framework for the foundation of the new core subject area in Computer Science dealing with the social and ethical implications of computer technology. This report defines the curriculum knowledge units in the new subject area to be a general set of principles and skills from social and ethical analysis to be learned and demonstrated by students using case studies and experimentation. Through the description of the new knowledge units, the report demonstrates how the theory, skills and principles of this subject area are applicable to all phases of the design and decision-making processes fundamental to computing.

Project

Making Good the Promise: A Regional Infrastructure Model for Science Education by Way of Electronic Field Trips

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The Vision

> The future is not something we inherit; it's something we create.
> (Lamm, 1994)

Just imagine students, from anywhere, exploring and researching deep sea habitats in the Monterey Canyon via datalinks from the Remotely Operated Vehicle (ROV) and working collaboratively with scientists to create electronic field trips of their own. Just imagine students producing poetry, art, and dance inspired by and reflecting their explorations of this new "ROV world." Just imagine....

The Intent

Building and sustaining a regional consortium and supporting partnerships to:

- establish testbeds, implementation models, and prototypes that explore the role of electronic networks (the Internet and others) in support of reformed education;
- support Research and Development needed for cost-effective implementation of educational networking including infrastructure, policy, training, curriculum, reform school organization, tools, materials, and mechanisms for technology transfer;
- strengthen collaborations between groups that are developing services, technical assistance and national connectivity, and larger educational communities, such as states and school districts.

The Project

A regional education consortium has been awarded a two-year $1,000,000 implementation grant by the National Science Foundation as part of the Networking Infrastructure for Education (NIE) program. In collaboration with regional educational institutions, scientific research agencies, and local business and industry, the grant will make possible the development by student/teacher teams of prototypes for creating "virtual" electronic field trips. These trips will be made available to students internationally to explore and research deep sea habitats in the Monterey Canyon using a wide array of content sources including datalinks from the Monterey Bay Aquarium Research Institute's remotely operated vehicle (ROV). Ultimately, student teams will use the model and the process to design their own trips in new habitats for their peers and others to take.

This project serves as a primary example of how a community must optimize opportunities as it faces critical and related issues systemic to education reform through restructuring and the need to make its public schools and universities more effective. As a result of abrupt changes in the economic base resulting from the end of the Cold War and massive military base closure, it stands as proof that, through collaboration across industry and education sectors both private and public, these issues can be addressed.

The regional collaboration is known as the Monterey Bay Regional Education Futures Consortium (MB ReEF). The primary participants in the consortium include California State University—Monterey Bay, Far West Regional Laboratory, Monterey Bay Aquarium, Monterey Bay Aquarium Research Institute, Monterey and Santa Crux County Offices of Education, Monterey Peninsula Unified School District, Naval Postgraduate School, Pacific Bell—California Research Education Network (CalREN), University of California at Santa Cruz.

Future plans of MB ReEF Consortium involve the continued collaboration of the various agencies to utilize their respective resources to prepare and submit a series of proposals that, upon funding, would broaden and sustain the current collaborative networking infrastructure around the Monterey Bay, focused on the environmental sector, to include linkages with the region's agriculture, tourism, and international trade and foreign language sectors.

Project "ROC" Out: A Story of CD-ROM Development

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Key Words: **scientific career exploration, multimedia and CD-ROM development, evaluation**

Background of Project

"ROC-CD" is a computer-based multimedia instructional program developed at the Medical University of South Carolina. This is the second in a series of programs designed to increase students' interest and awareness in the areas of engineering, mathematics, and science. Designed for middle school students, "ROC-CD" uses environmental issues and related careers as a basis for introducing these various scientific disciplines.

A portion of the program's content focuses on the need for recycling and conservation, and is found through a title in the main menu, "Do It To It." Games based on the program's content compose the area known as "Thrillers." "ROC Videos" contains two general *QuickTime* movies on recycling and conservation: "Trashy Clothes" explains the process of recycling plastic into fabric, and "French Fried" demonstrates the conversion of potato skins into recyclable plastic bags. Four other *QuickTime* movies in this section focus on specific environmental careers: polymer chemist, mechanical engineer, microbiologist, and textile chemist. These careers are related to the processes explained in either "French Fried" or "Trashy Clothes." The section called "Talent Fusion" consists of two *QuickTime* movies: one of these explains how the program was designed and actually produced, and the other focuses on the individuals involved in putting the CD-ROM together.

Project Development

Curriculum coordinators, administrators, teachers, and students throughout the Charleston County School District were involved in the design, development, and evaluation of "ROC-CD." Content experts from the Departments of Physiology and Microbiology at the Medical University of South Carolina, an instructional designer, a computer programmer, and a graphic artist composed the core development team.

Development of ROC-CD followed a process outlined at the beginning of the project:

- Needs and audience analysis
- Development of goals and objectives
- Flowcharts and storyboards written
- Interface design
- Video scripts and narrations written
- Multimedia components collected (e.g., video, music, and graphics)
- Production
- Formative evaluation conducted throughout process

During the needs and audience analysis phase, over 150 students were asked to discuss their preferences in computer programs, as well as their knowledge of the proposed content. Following analysis of this information, the development team incorporated results deemed critical to the effectiveness of the program.

As the development team moved forward, they were aware of the importance of the design and production process, but they were also aware that formative evaluation was critical to the success of the program. Therefore, the team formulated a plan to evaluate three main areas of the program throughout the development process:

- Ease of use (user evaluation)
- Program performance (functional evaluation)
- Accuracy, clarity, and depth of content (content evaluation)

The two schools selected as evaluation sites included one in an urban and one in a suburban setting. Observations, interviews, questionnaires, and pre- and post-tests were the tools used to determine the program's effectiveness. As a result of these evaluations, the development team made appropriate changes to the program. The team also made the decision not to return the program to the schools for a second evaluation since results from the first evaluation required only "cosmetic" changes to the program. However, numerous in-house functional evaluations were conducted following these "cosmetic" changes.

Throughout the formative evaluation process, not every suggestion made or mistake observed resulted in a change to the specific program. If users were observed having problems in the same areas of a program, or the same suggestions made by various users, the development team discussed the potential problem areas, along with the pro's and con's of possible modifications. The team then compared these proposed modifications to its previously detailed design plan. Modifications resulting in significant variations from the design plan were not made since the program would have moved further away from its original goal, changes would have continued, and the project would have never reached completion.

In total, over 200 students used and evaluated the program. Evaluation results indicate that:

- 93% met all of the objectives;
- Prior to using the program, 8% could name and describe one environmental career; following use of the program, 80% could name and describe at least one environmental career;
- Prior to using the program, 40% said they would like to learn more about environmental careers; following use of the program, 70% indicated that they would like to learn more about environmental careers;
- 97% related that they enjoyed using the program.

On the basis of these statistics, the development team considered "ROC-CD" a success. Factors contributing to its success included:

- Detailed design plans with a realistic timeline;
- A design team that held organized and frequent meetings;
- Enthusiastic and cooperative educators and students;
- Clear and open communication maintained between everyone involved.

Future Plans

Future computer-based multimedia instructional programs developed by the Educational Technology Laboratory at the Medical University of South Carolina will require customized development processes. However, basic features and issues will remain the same as those used throughout the development of "ROC-CD":

- The involvement of as many people as possible, as soon as possible (e.g., users and subject matter experts).
- The knowledge that observations are essential; relying solely on interviews or written questionnaires does not allow observation of important factors (e.g., individual methods of navigation; body language in reaction to content and/or examples).
- The program's ease of use, functionality, and content will remain as three major areas of evaluation.

Access a short video on "ROC-CD" via the Internet at *http://www.gradstudies.musc.edu* (select "Other Information on MUSC"). For ordering information, contact Dr. Curtis Wise, Dept. of Physiology, Basic Science Building, Room 401, MUSC, 171 Ashley Ave., Charleston, SC 29425; (803) 792-2486; curtis_wise@smtpgw.musc.edu

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Society

Cyberschool in Cyberville Comprehensive Model for Traveling over the Internet (CCSC)

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Cyberville is our view for connecting the many diverse and scattered resources in our community and enabling the sharing of these resources by the entire community. Cyberville is the infrastructure necessary to permit access to the information superhighway for the many individuals, businesses, organizations, and agencies within our community. As the information superhighway expands, the infrastructure must be further refined and defined. Conventional highways have many levels: (1) interstate highways, (2) intrastate highways, (3) county roads, (4) city streets, and (5) individual driveways. Each has a different purpose, function, and capacity. Also, each has a different agency responsible for maintenance. Without each of these levels, individuals cannot fully access our nation's resources. This highway infrastructure provides an invaluable network for the distribution of goods and services to the citizens.

The same should be true for information resources. The national information superhighway is currently providing the first two levels, and Cyberville will provide the next three. Cyberville directs effective and efficient expansion of the superhighway to local communities. Just as it is not feasible to allow an individual's driveway to directly access the interstate, controlled access must be provided for the individual users as the information superhighway grows. This controlled access will allow for the most efficient use of the connected resources.

Cyberville consists of a high-speed, fiber-optic network connecting the major resources in the community. Within Cyberville, the physical boundaries of our community do not exist. The only limits are the resources needed to perform its functions. Resources that could be connected include: all local elementary and secondary schools, including public and private schools; institutions of higher learning, including universities, community colleges, and vocational schools; governmental agencies; businesses; hospitals; museums; libraries; and individual households.

The benefit of this model is distributed, community access to the national information superhighway with centralized control. Physical infrastructures are separate and connected with a gateway or bridge. This allows each individual in Cyberville access to the superhighway, but does not require a separate node on the superhighway for each individual.

Many believe that consolidation of schools has proven to be detrimental to student achievement, because the individual sometimes gets lost. Within Cyberschool, the focus of learning is on the individual while utilizing consolidation to gain economy of scale. Integrating technology into the traditional classroom arrangement is key to the successful Cyberschool. Integration must be pervasive and all encompassing, from the elementary school through the twelfth grade. Every student must have unencumbered access to all the resources of the Cyberschool.

Individual assessment on demand, individually directed study, and custom curricula become the norm in Cyberschool. Administrative functions will be conducted more effectively and efficiently without an adverse impact on learning. A comprehensive, complete, and active educational record can be maintained on each student in Cyberschool. This record can be transferred immediately with the student to any location within Cyberschool. Declining trends in student performance will automatically warn guidance counselors and teachers of potential problems. Early intervention will save more students and educational resources.

In a Cyberschool classroom, each student has their own computer. It becomes the new tool for delivering instruction, not a panacea. Wireless communication provides unobtrusive connectivity within each classroom. This allows easy incorporation of computers into the classroom. Classrooms are not modified nor are new schools built. Also, the computers can be moved easily from one classroom to another to handle class size changes. The teacher's computer is connected to a computer that serves the entire school and connects the school to the information superhighway, providing students access to local, state, and national educational resources.

The connectivity in Cyberschool is impressive, but the use of that connectivity is even more so. For instance, high school students are able to work on research projects with students anywhere on the local, state, or national information superhighways. Mentor relationships are established among students to overcome existing disadvantages. Cyberfield trips and excursions are everyday occurrences. Advanced placement classes are a reality for every student wanting to take them, regardless of location. Inservice is a daily activity for teachers. Teaching teams handle classes shared among schools. Pedagogical research is conducted by many and shared by all.

This is Cyberschool at its best. To develop Cyberschool, each high school will be connected to a fiber-optic backbone. This is called the CyberNet. In each school, an interactive learning center will be established. This center will possess full-motion, interactive video, voice, and data capabilities.

Each high school will serve as the hub for a local area network connecting all schools within the immediate vicinity. This is called the SchoolNet. It is actually two networks in one. The primary network is the instructional network and the secondary network is the administrative network. They use the same physical infrastructure, but are logically different. The two networks are connected and possess two-way communications.

Within each school in the SchoolNet, the principal's office will house the network server. Each classroom will be connected to the server. This is the ClassNet. This configuration will allow teachers to share ideas and instruction. Also, students among the classrooms will be able to communicate with each other, and access the outside world.

Finally, within each classroom in the ClassNet, the teacher's computer will act as the network server. Every student will be connected to the server using wireless communications. This is called the StudentNet. It allows for the effective distribution of information and assimilation of data.

Society

Using the World Wide Web in the Classroom: MidLink Magazine (ISTE/SIGHyper)

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Key Words: **telecommunications, World Wide Web, Internet, link, schools, electronic publishing**

How can teachers incorporate the Internet into the regular classroom? How can educators assess Internet activities? How can busy teachers include Internet projects in a variety of disciplines and grade levels? How can we protect students from the dark side of the Internet? What makes a Web site a popular spot? These issues and more will be addressed by classroom teachers who create '96 "Best of the Net" winner, *MidLink* Magazine.

Project
Multimedia Research Journal on the Web: Testing the Waters

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Key Words: **multimedia, Internet, World Wide Web, research journal**

The *Journal of Research on Computing in Education* will release at NECC '96 a special extra issue (v. 28 #5) published simultaneously on CD-ROM and on the World Wide Web. Diane McGrath is the guest editor, and graduate students from Kansas State University's program in Educational Computing, Design, and Telecommunications will produce the multimedia journal issue. This issue will be devoted to qualitative research articles, and will be produced in HTML with multimedia enhancements. Our research has led us to believe that this is the first such project of this type. Most online journals are text-only or text with header graphics. ISTE (The International Society for Technology in Education, the society which sponsors the JRCE) is using this special test issue to explore the possibility of changing the JRCE to digital format permanently.

The main reason for choosing to enhance a digital journal with multimedia is the nature of the particular research to be reported on. Qualitative research tends to be very wordy, but print journals have page limits, in this case 20 typed pages. The goal for writing up qualitative research is to give a thick description of the observations, to illustrate and support the conclusions the author draws. A publication which makes it possible to present qualitative research findings using multimedia enables, for example, a five second digital movie to both save several pages of writing and make it more clear to the "reader" what was really going on at the time the observations was recorded.

The project presentation will begin with a description of exactly how the planning, development process, and implementations occurred, and what the plans are for evaluation. The journal will be browsed for public viewing, and a discussion of the problems, successes, and recommendations for further work on a project of this type will follow. Time will be allowed for a question and answer period.

Project
The Explorers of Tennessee

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Key Words: **Integration, World Wide Web resources, middle school**

The Explorers of Tennessee is a project designed to integrate Internet, World Wide Web, and networking technologies into classroom curriculum using SLIP, PPP, and TCP protocols. Explorers span the entire state, all grade levels, and crosses barriers between public and private schools.

During this project presentation participants will learn middle school classroom strategies for using World Wide Web resources. These strategies will include descriptions of research locations and site descriptions on the Web. Topics will include:

- The Stock Market
- The Great Depression
- Rivers of the World
- States on the Web
- World Wide Web Multimedia Newspaper Design
- Web Page authoring ideas

In addition, presenters will share other Explorer project developments including:

- University School of Nashville Astronomy projects
- Elementary Native Indian projects
- Grant Writers' project
- Paideia Home Page project

Society
How Can We Make Computing Courses More "Female Friendly?" (CCSC)

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Key Words: **women students in computing, non-traditional teaching approaches for women, statistics on women in computing**

This panel discusses the problem of underrepresentation of girls and women in computing courses in high schools and colleges and the result this has on the representation of women in computing professions. Most young women have chosen not to pursue this area of study before they reach college. What is happening in the high schools to account for this dramatic change? The need for colleges and high schools to be aware of and actively facilitate a "friendly" classroom atmosphere for female students in computing classes has been identified primarily because of this dramatic reduction of women students choosing these courses. Members of the panel represent small undergraduate programs that specialize in quality teaching. Each has been active in identifying the issues and finding solutions.

Gail Miles offers an introduction of the problem. Sue Fitzgerald provides a general overview and specific statistics. Another population that is significantly underrepresented in college courses is the non-traditional woman. Becky Tidwell addresses some of the issues associated with this group and some strategies that are successful. Finally, Kevin Treu explains specific strategies that are being used in college computer classes to help women students become more successful.

Panelist Topics

Sue Fitzgerald

Statistics show that females are underrepresented in the field of computing. This trend grows worse as the level of education increases. Although girls do well in their science and math classes, they frequently elect not to continue in math and science. Several key decision points have been identified. Suggested reasons for reduced involvement include low self-esteem, societal and familial expectations, and teacher bias. Recommendations from women who are successful computing professionals include altering sterile lab environments to be warmer and more welcoming; shifting the focus of activities from competition between individuals to cooperation within groups; providing female mentoring and role-modeling; and assigning projects more appealing to females.

Becky Tidwell

Becky Tidwell targets the nontraditional female student. She is often over twenty-five years old, has one or more children, possibly divorced, and on a limited income. She has recognized her need to obtain a college education and desires to enter a field where the monetary rewards are high. Many of her male counterparts have worked with computers for quite sometime during the time she was "out-of-circulation." Now she is competing with male students who not only have a great deal of experience with computers but who probably own their own computer. The discussion centers around how we can get the computer hardware/software into the hands of these women in order to give them the same advantages as those who have been more fortunate than she, through such things as grant proposals and resources for obtaining equipment in support of their education.

Kevin Treu

The creation of an inviting, nurturing environment for women in the discipline of computer science has been a difficult problem. The scarcity of women in undergraduate CS programs nationwide has concerned and befuddled academicians and employers alike in the last decade. Explanations include a comparative lack of self-esteem due to subtle prejudice and disrespect from instructors and colleagues, the scarcity of female role models, and the predominant view of CS as the domain of socially maladjusted males, ("geeks," if you will).

Recent efforts have focused primarily on explicit recruitment and the out-of-class experience of prospective CS majors. In an ongoing project at Furman University, we are concentrating instead on breaking the prevalent stereotype by reconsidering how our "non-major" class is taught.

Their designed course consists of five interleaved components—history of computing, computing applications, problem solving, current research, and ethics—using multimedia computing as the central organizing theme. The course incorporated gender issues with each of these components in different ways. In addition, we have studied the important issue of how pedagogical strategies can have a positive or negative impact on the perceptions of women students.

This to be a relatively novel, but important approach to the general problem of flagging interest in computers and computing on the parts of women.

Paper

A Collaboration to Apply Advanced Information Technologies in Education

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Key Words: **Information technology, Living Schoolbook project, EII services, K–12**

Abstract

A collaboration between teachers, education researchers, and computational scientists to apply advanced information technology in the K–12 classroom is described. Over the past year in the Living Schoolbook project, prototype Education Information Infrastructure (EII) services were developed, teacher team training conducted, and teacher projects to create multimedia content for EII services established. Large scale projects combining the expertise and resources of teachers, education researchers, computational scientists, the media industry, and computing and communications vendors are needed to develop education as a National Challenge application.

1. Overview

Our nation's schools struggle with an inadequate technology infrastructure, and our national workforce will soon lack the technical skill to compete in an information driven global economy. Education is one of our "National Challenges" (National Coordination Office, 1995).

This paper describes the early stages (now beginning year two) of the Syracuse University Living Schoolbook project to demonstrate a vision of the future using high risk high gain approaches with advanced technologies in education. We describe two EII services which support new, individualized, interactive models of learning. Our approach is based on a client-server model linking high performance multimedia servers at the Northeast Parallel Architectures Center (NPAC) with clients in the project schools over a gigabit testbed network. We are demonstrating leading technological approaches, and migrating our infrastructure design toward more widely available delivery strategies.

The recent convergence of the World Wide Web (WWW), the National Information Infrastructure (NII), and high performance computing and communications (HPCC) technologies is an important advancement that will further industry application of advanced technologies (Fox and Furmanski, 1995). Education too should exploit this opportunity, but this will require large projects and interdisciplinary teams. Our project combines temporary government funding, teacher teams, university researchers, content providers, public access, network support, and computer and communications vendors.

Current Status of the Living Schoolbook Project

To summarize our experiences over the last year in the Living Textbook Project (Mills et al., 1995a, Mills et al., 1995b), now called the Syracuse University Living Schoolbook Project, we have:

- built a partnership of teacher teams, computational scientists, and education researchers with startup New York State funding;
- implemented a prototype state of the art Education Information Infrastructure based on NYNET, a wide area gigabit network donated to this project by the NYNEX Corporation;
- created two prototype Education Information Infrastructure (EII) services that run in our laboratory and are under test in our project schools (Fowler High School in Syracuse, NY, Rome Free Academy in Rome, NY, and Whitesboro Middle School in Whitesboro, NY;
- developed a process that allows teachers to leapfrog technical obstacles and create multimedia content for EII services that is integrated into their curricula.

The Living Schoolbook project has established a useful start and we argue that more of these types of projects are needed in order to understand the details of applying the nation's leading information technologies in education.

Section 2 describes our concept of EII services with illustrations of current prototypes. Section 3 describes our collaboration among project teachers, education researchers, and computational scientists. Section 4 summarizes our conclusions and recommendations on technology and education development projects.

2. Overview of EII Services

Education Information Infrastructure (EII) services are specialized services for education built on the National Information Infrastructure (NII), hence the name EII. We use the term EII "services" to distinguish the software we develop from software "applications" such as a text processor or graphics package. EII "services" might also be seen as "resources" that the teachers use to support existing approaches or create new electronic lesson plans. EII services leverage rapidly advancing World Wide Web, NII, and HPCC and grow as the supporting technologies grow.

EII or digital information services for education are important because they offer an ability to index, retrieve, and customize content for individual learner use. This supports learner-driven navigation, linking concepts and media formats, and crossing traditional disciplines to create interactive models of learning.

Prototype EII Services

We have two EII services under development in the Living Schoolbook project—a Network Exploratorium and an Interactive Journey. The Network Exploratorium is a digital library incorporating digital video, image, and text content in a client-server model. This digital archive can be browsed and searched over the network providing a multimedia "information on-demand" resource in our project schools. The very successful Kids Web project (Coddington, 1995a) prototypes the Network Exploratorium.

We use a web interface to a text retrieval engine (currently freeWAIS SF) to search video content based on descriptive text (closed captioned text). Teachers and kids can search the text database, retrieve a video clip based on the search, and view the MPEG clip over the NYNET ATM network. We also have examples of image on-demand and text on-demand databases accessible to project schools over the Web.

The Interactive Journey, still in software development, is based on a digital terrain and landcover database, a graphics rendering program providing terrain navigation, and web links to spatially-located multimedia databases (Coddington, 1995b). A geographic information system is a natural way of organizing spatially located databases. We believe that real time three dimensional navigation of our state or local region will provide a compelling educational environment for learners.

The Albany, New York, area in our Interactive Journey of New York State will allow students to navigate the state, stop in a region of interest, and link spatially located multimedia databases via web buttons.

Building EII Services

Within the next five years, we expect the infrastructure required to deliver EII services to schools to become widely available. Today we can build useful interfaces to text and image content sources with plain old telephone service and high speed modems. However, digital video delivery places an approximate 100 times greater performance requirement on the infrastructure.

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Powerful PCs and set top boxes connected to high speed networks is a likely scenario for 100 million homes, offices, and schools. Decoding a compressed video stream at the client end requires a powerful processor (software approach) or specialized video decompression chips (hardware approach). Full-screen NTSC digital video requires a network performance of 1.5 megabits per second. Phone line modems deliver one percent of this performance, and ISDN phone lines delivery ten percent of this performance (128 kilobits per second). We expect that education, business and other non-entertainment applications will be well served by a network providing less than full-screen thirty frames-per-second video quality.

Building EII services and using them in the classroom is an integration task connecting seven project layers ranging from the underlying technology base to assessing the impact on learning in the classroom. Table 1 below outlines seven project layers and associated products and in the project.

Table 1. Project Layers and Associated Products and Activities in the Living Schoolbook Project

Project Layer	Products/Activities	By Who
1. Assessment	Impact of EII services on learning	Education Researchers
2. Classroom	Teaching, learning, creating content	Teachers, children
3. Curricula	Modules, teaching units, frameworks	Teachers, Education Community
4. EII Services	Network Exploratorium, Interactive Journey	Computational Scientists, Teachers
5. Living Schoolbook Prototypes	Kids Web, multimedia databases	Computational Scientists
6. Core NII Services	video on-demand, web navigation, multimedia	Computational Science Community
7. Base Technologies	World Wide Web, NII, HPCC	Computational Science Community vendors

Teachers lead Layer 2. Classroom teaching, learning, and content building activities; project computational scientists build Layer 4. EII Services, and Layer 5. Living Schoolbook prototypes. Project education researchers lead Layer 1. assessment activities and work with teacher teams and computational scientists to integrate layers 2 through 5.

The Living Schoolbook project attempts to apply in education what has become a standard approach in all other National Challenge applications (e.g., civil infrastructure, digital libraries, energy management, environment, health care, manufacturing, national security, public access to government information). The elements of this standard approach include:

- using an infrastructure established for other purposes, an extension of the dual-use concept (military technologies applied in public sector) to multiple-use, all

National Challenge applications must use the same national infrastructure, note that our project does not build Layer 7. Base technologies in Table 1 above;

- a hierarchical client-server model, which is the most cost-effective approach, the model of millions of clients accessing a few thousand information servers over networks was enabled by the World Wide Web and reverses the trend toward standalone desktop computing of the 1980s;
- using scalable technologies, which is essential to building and managing cost-effective large systems, this approach established by the 1992 High Performance Computing and Communications Initiative which established the national Grand Challenge science program and advanced HPCC technologies;
- modular components, following the principle of software re-use which is essential in today's rapidly changing technology industry, products tend to be obsolete the moment they are introduced when developed by traditional software engineering practices;
- community technology standards, which are necessary to all of the above goals, systems must be open, portable, and interfaced with the Web.

Current education and technology initiatives tend to emphasize equality of access, the lowest common denominator for technology, and teacher driven initiatives. These are certainly critical issues, but for schools to leapfrog the present situation of a non-existent technology infrastructure into the modern information age of the 21st century, we must bridge the gap between the classroom and the advanced technology R&D lab.

We invested a great portion of the resources of the Living Schoolbook project to link classroom teachers with computational scientists to carry out the integrated set of activities outlined in Table 1. K–12 teachers do not have direct access to core NII services such as video on-demand technologies, or base HPCC technologies such as high performance database servers. Teachers need computational scientists for their technical expertise as computational scientists need teachers for their educational expertise. We recommend this as an appropriate model for funding agencies to consider while developing education as a National Challenge application.

3. Building a Collaborative Development Model

Section 2 outlines our concept of EII services and describes some of the integration tasks required to deliver these services over a network to the classroom. How do we go about developing rich sources of content and put these resources in a useful form for the classroom?

Our approach was to implement the project infrastructure (NYNET ATM gigabit wide area network) and project workplan over the first nine months of the project. The infrastructure design was top-down. The workplan, however, was outlined generally and crafted to allow a wide range of control for the schools and teacher team members. We developed a set of prototype EII services which teachers explored and made recommendations on how to improve. Our project coordinator is a classroom teacher who links project partners and the schools while serving as coach for the teachers as they negotiate the technology and the research and development environment of the project.

We conducted a series of teacher team workshops (10/94, 1/95, 3/95, and three in summer of '95) to build ownership in the project by teachers, and true collaboration between teachers, education researchers, and computational scientists.

Training Sessions

Training sessions were held using a "jigsaw" instructional setting where after an introduction, teachers selected areas of interest for further training: client technologies (Power Macintosh and Silicon Graphics Indy), video conferencing, and Kids Web, the Network Exploratorium prototype. Training sessions built technical confidence among the teachers who then served as an "expert" for their school colleagues. This model of training minimizes the time project teachers are asked to leave the classroom, maximizes the time teachers spend together in groups, and builds teacher interest and confidence in the project.

Multimedia Content Development

In the project startup phase, we provided technical training and proposed that teachers create web sites for their schools. Teachers maintained control of the design, content development, and pace of production.

During the June, July, and August '95 workshops, teacher teams designed projects around our prototype EII services. To address curricula issues, teachers early on determined what content would be meaningful to students and useful in classroom projects, and designed multimedia projects around the Network Exploratorium and Interactive Journey services. Design and content production is led by the teacher teams; project computational scientists incorporate the content into NPAC databases interfaced to the web, and deliver these services via NYNET to the project schools.

Three Whitesboro teachers (middle school science, history, and computers) designed a local component of the Interactive Journey where students visit the Herkimer Home, a local historical site, and "tour" the architecture, artifacts, gardens and natural history, the site, the location of the site, and its historical significance (see Figure 3). Two Rome teachers (art, social studies) designed an Exploratorium project based on historical art in the Central New York region. Drawing on small museums, publicly owned paintings, and the Oneida Indian Nation, this project documents folk art, Native American, and Work Progress Administration art styles and its historical context. A team of Rome/Fowler teachers (English, Journalism, Foreign Language) designed a community ethnology project to link Web-based content on race, age, and gender with video-taped interviews by students of various community groups to create a database on local social perspectives.

Nearly a year into the project, during the stage of multimedia project, design teachers put aside the technical obstacles they were struggling with (e.g., web, client machines, file transfer) and concentrated on developing innovative educational services. This step by the teachers is absolutely necessary to our project model of collaboration between educators and computational scientists to create innovative education services.

Technology Issues

Our success in implementing a state of the art information infrastructure for education, developing prototype EII services, and establishing a process for building educational content by teacher teams resulted from a dedicated effort to build an innovative project by all partners involved (see Mills et al., 1995a, 1995b).

Must technology work the first time for teachers to proceed? In the Living Schoolbook we are attempting a high risk, high gain approach. Teachers use a research network that is susceptible to downtimes due to experiments, demonstrations, and routine network upgrades. We have found that teachers can work in the same volatile environment as researchers. Difficulties with technology of course occur and are disruptive. Obstacles in our project ranged from a personal level (a teacher may find it difficult to innovate after

30 years of traditional teaching), to very specific hardware issues such as machine crashes, file transfer problems, unfriendly UNIX security warnings, and Internet performance issues.

4. Summary and Conclusions

The approach of teaming application experts with computational scientists had worked successfully in many disciplines (Fox, Williams, Messina, 1994). Large systems, advanced technologies, and multidisciplinary teams have been used to advance other Grand Challenge and National Challenge applications, and should be used in education too.

However this approach does not appear to be embraced by the education community where emphasis is focused on teacher-led initiatives, bottom-up program design, and the poor state of our schools' technology infrastructure. We contend that we also need leading examples to show what could be done with advanced technologies in the classroom. The Living Schoolbook Project is a useful start but many more of these projects are needed to understand the implementation details of using advanced technologies to improve learning.

In a collaboration between teacher teams, education researchers, and computational scientists, we prototyped two Education Information Infrastructure (EII) services, a Network Exploratorium and an Interactive Journey. The Network Exploratorium is a general multimedia digital library built on a client server model delivered over a high speed network to the classroom. *The Interactive Journey* is a spatial organization of multimedia databases built into a three-dimensional navigation environment. Teachers are creating multimedia content and computational scientists are building the high performance multimedia database servers to host these services.

Building EII services is primarily an integration task; we defined seven project layers (assessment, teaching and learning, curricula, EII services, project prototypes, core NII services, and base technologies) combining the expertise of teachers, education researchers, and computational scientists. To advance education as a National Challenge application, it is clear that computational scientists need the education expertise of teachers, and teachers need the technical expertise of computational scientists. We observed a major step at the conclusion of year one in our project when teachers put aside technical obstacles and began to design innovative classroom projects and build supporting multimedia content. A state of the art technological environment is by nature subject to occasional downtimes and failures, but teacher demonstrated that they can work in the same volatile development environment as researchers.

Glossary of Terms

ATM—Asynchronous Transfer Mode

EII—Education Information Infrastructure

HPCC—High Performance Computing and Communications

ISDN—Integrated Services Digital Network

LSB—Syracuse University Living Schoolbook Project

MPEG—Movie Picture Expert Group

NII—National Information Infrastructure

NPAC—Northeast Parallel Architectures Center at Syracuse University

NTSC—National Television Standards Committee

NYNET NYNEX Corporation wide area ATM network

WWW—World Wide Web

References

Coddington, P. 1995a. Kids Web, A World Wide Web Digital Library for Schoolkids. *http://www.npac.syr.edu/textbook/kidsweb*

Coddington, P. 1995b. Overview of NPAC's Terrain Rendering Project. *http://www.npac.syr.edu/projects/terrain*

Fox, G., Williams, R. and P. Messina. 1994. *Parallel Computing Works*. Morgan Kaufmann Publishers, Inc. *http://www.infomall.org/npac/pcw/*

Fox, G. and W. Furmanski. 1995. The Use of the National Information Infrastructure and High Performance Computers in Industry. NPAC Technical Report SCCS-732. *http://www.npac.syr.edu/techreports/index.html*

National Coordination Office for High Performance Computing and Communications. 1995. *http://www.hpcc.gov/blue96/*

Mills, K., Fox, G., Coddington, P., Mihalas, B., Podgorny, M., Shelly, B., and S. Bossert. 1995a. The Living Textbook and the K–12 Classroom of the Future. to be published in Supercomputing '95. San Diego CA. NPAC Technical Report SCCS-731. *http://www.npac.syr.edu/techreports/index.html*

Mills, K., Fox, G., Shelly, B. and S. Bossert. 1995b. The Living Textbook: A Demonstration of Information on Demand Technologies in Education. NECC '95. Baltimore, MD. NPAC Technical Report SCCS-647. *http://www.npac.syr.edu/techreports/index.html*

Project
PDS-Link and MentorNet Building a University and K–12 Community

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Key Words: **K–12 schools, teacher preparation, Internet, mentoring, telecommunications**

An important goal for the College of Education at Louisiana State University is to support and enhance teaching and learning in Louisiana schools by providing electronic communication and information resources to teachers and students. Through the involvement of two key projects, PDS-Link and MentorNet, the College has used the power of the Internet to promote communication and collaboration in the preparation of future teachers and in their continued support of local educators. This presentation will describe the College's role in these projects and the impact they have had on the teacher preparation process and the local teaching community.

In their goal to promote better communications with teaching interns in K–12 schools, the College provided their Professional Development Schools (PDS) with a Macintosh computer and printer, equipped with a modem. Training, essential at various levels, was provided for university faculty and teaching interns, as well as the supervising teacher, principal and/or librarian at each school. In addition to the e-mail account, the schools were also given full Internet access. The goal of PDS-Link was simply to make communications between key personnel in the teacher preparation unit more efficient and functional. Having Internet access also allowed the teaching intern to maintain a link with the university's multitude of resources while out in the field.

In its goal to promote the use of telecommunications as a tool for collaborative research for teachers, the MentorNet project was initiated by Academic Affairs. Promoted and launched by the College of Education, MentorNet provided e-mail accounts to local teachers to interact with each other and with LSU faculty on collaborative projects. Faculty volunteers both inside and outside the College of Education served as mentors to advise and assist in projects when needed and referred them to other colleagues if necessary. Teachers were encouraged to use a 'project-oriented' teaching approach to draw upon faculty expertise on campus that would eventually help them in forming and maintaining cross-disciplinary, inter-institutional working relationships.

These projects have allowed the teaching interns, as well as the schools they serve, the opportunity to witness the power of technology as a valuable tool for communication and collaboration that ultimately enriched their teaching and learning experience. By setting up a framework to make the communication network expand and curriculum-based exchanges take place, the College of Education was instrumental in forming strong connections with the local schools.

Project
Creating Multimedia Learningware in Science

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Key Words: **multimedia, physical science, technology, learningware**

A few years ago, a couple of teachers came up with the idea of teaching Physical Science content and incorporating computer technology within daily science lessons. Since then, each year when freshmen come to Cotter, we teach them "Technology-Enhanced Physical Science." Third quarter is devoted specifically to a ten-week multimedia learningware project.

Students work collaboratively in groups of two or three to thoroughly investigate and research an issue dealing with a particular science area. Last year the topic was space science, and this year it is "Our Ocean Planet." During this ten-week multimedia project, students learn how to create a data base and draft a business letter to send to ten different companies or contact people requesting current information pertinent to their topic. They then merge the business letter with the database to personalize their letters and create mailing labels. Students receive many different types of resources. Valuable information comes from pamphlets, brochures, fliers, and research summaries. Other things sent include buttons, stickers, posters, and photos, which students use to decorate their booths. Traditional research is done through the library, stressing information gathering skills and source citing. This year we take the advantage of World Wide Web and e-mail system. Students do the research online, finding valuable information on the Web and requesting information from different institutions by using e-mail. Other research for the project is done electronically using various CD media including *News bank*, *MAS* (Magazine Article Summary), *Grolier's* and *Compton's* multimedia encyclopedias, clip art, and *Image Pak*. Students are asked to cite their information properly according to the specific formats, especially information found with the Web and e-mail. The freshman groups are asked to compose a newsletter that is used to help organize their ideas and research. These newsletters are displayed throughout the school to create interest in their presentations during the development stages.

Students also work on creating spreadsheets of statistics from research gathered on their topics and putting these statistics into graphs. They gather pictures appropriate for their topic and use the flatbed scanner to bring them into their project. Many groups use still or live video footage to document interviews they conducted with experts on their topics. Using *HyperCard*, all information gathered is brought into one interactive multimedia presentation that may be used for others to view and learn about the topic explored. At the completion of this ten-week endeavor, each group project is exhibited at a Science Fair that is open to our school and community with students on hand to answer questions about their presentations.

The main benefit this project has for students is an increased excitement and responsibility for their own learning. Students are able to choose a particular science topic that interests them personally, therefore learning is self-directed. Discovery learning and an active, involved approach are the main directives in this project. Small groups chosen in this project facilitate learning cooperative skills and increased group dynamics. During the course of the ten-week project, each group member is asked to set weekly goals and is responsible for particular tasks which stress accountability. Group goals are also set and reset each week, therefore, leadership and group management skills are consistently developed. The teacher reviews group and individual goals every week to help facilitate the success of the project.

Evaluation is done using a rating system to check for mastery of certain criteria. Our goal in assessment is to objectively measure the student's ability to find and organize information and also to measure their perseverance and quality of work. This grading scale for assessing our projects demands excellence and student success.

- E=Exceeds criteria (Student has demonstrated skills and abilities beyond expectations of the assignment.)
- M=Meets criteria (Student has completed all tasks.)

- NY=Not Yet (Student has not yet met the criteria of the assignment.)
- I=Incomplete (Student has not met the requirements of the assignment.)

The group also do a group performance and self evaluation survey. They are asked to list contributions made by each member in the group and to describe any problems encountered as well as the steps that their group takes to solve these problems. They are also asked to rate their group performance and quality of their overall project.

Finally the Science Fair gives the freshman a wonderful opportunity to involve the entire school as well as the Winona community. The students reserve the day of the Science Fair to provide support for their presentations and the community is encouraged to witness their creativity and ingenuity. We also invite students from the local grade schools to walk through the fair and observe the freshman presentations. The students create booths and exhibits that surround their computers and are on hand to answer any questions about their project

Focus

Focus on Teacher Training for Technology Integration: A New Age

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Key Words: **technology, teacher training, computers, computer integration**

Project SMART is a three year project funded by the US Department of Education to help science and math teachers integrate computer technology into their classroom instruction. The purpose of this paper is to describe how to create an instructional environment for the constructive use of computers in the classroom. Our focus is on the development of technological competence that we believe is essential for creating an instructional environment conducive to the effective integration of computer technology in the classroom. We are accomplishing this goal through extensive training and follow-up support for the classroom teacher.

Philosophy

Our focus in Project SMART is on developing the technologically competent teacher (Morrison, 1995). One of the problems with current teacher training programs and workshops is the emphasis on computer literacy skills that teach teachers how to turn a computer on, how to connect peripherals, and how to send a document to a printer.

This computer literacy approach is based on teaching methods first used in the early 1980s when computers were introduced into the American classroom. Today, such an approach does little to prepare a teacher for integrating computer technology into the classroom, and often leaves the teacher with the lack of necessary skills to use the technology successfully (Durham, Morrison, Ross, 1995).

Project SMART training emphasizes three critical factors. **First**, the computer is a tool to use for solving problems. Participants learn to use *ClarisWorks* to create databases and spreadsheets the student can use to manipulate data to solve problems. We do not emphasize or teach software that is of a tutorial or drill-and-practice genre. **Second**, teachers learn to assume the role of facilitator rather than maintain the center of attention and information in the classroom. They provide the students with information and data the students can work on in groups or individually. **Third**, teachers learn how to manage the classroom environment to make effective use of four or five computers in a class or 20 or more students. The limited number of computers in each classroom requires careful planning of the full environment to ensure equal access to the computers and efficient use of time on other instructional activities.

Training

Technological competence is the next step beyond computer literacy. It is characterized by an individual who can think conceptually about the applications of a microcomputer in relationship to learning. This individual views the computer as a tool to solve problems, to provide rich data sets, to compress or expand time, and to simulate real-world events. Using this focus, our training program was designed to develop technological competent teacher who designs, facilitates, and manages a student-centered multidimensional learning environment that embeds the use of technology into the instruction (Morrison, 1995). Three primary factors contribute to a multidimensional environment: the configuration of the students, the learning tasks, and the supporting resources. The role of the computer is somewhat subdued in a multidimensional learning environment. The computer is not what students learn about, but rather it is a tool they use for learning.

The application of technological competence requires that the teacher assume three primary roles: designer, facilitator and manager. To design appropriate lessons for a multidimensional learning environment that embeds technology, the teacher needs to understand the relationship between the basic functions of computer applications and learning. This understanding provides the basis for selecting appropriate learning strategies. For example, Kemp, Morrison and Ross (1994) suggest that learning strategies should be selected based on the type of content the students are learning (facts, rules, concepts, procedures, etc.) and the type of expected performance (recall or application). Another consideration for designing lessons that embed technology is the ability to find, retrieve, and critically analyze learning resources.

If a classroom is to be student-centered and have learners actively engaged in using multiple resources to solve real-world problems that they have collaboratively defined, a teacher's role must change from that of a disseminator of knowledge to a facilitator of student understanding (Duffy & Jonassen, 1991). A technologically competent teacher not only models the physical processes, such as how to create different types of fields in a database, but also provides cognitive modeling of the thinking processes necessary to achieve the learning task (Gorrell & Capron, 1990). For example, the teacher would help the students to determine if the fields selected for the database will yield the desired results. This type of facilitation is used throughout a lesson by the teacher purposefully framing the learning task and asking directed questions to stimulate and guide student thinking and decision-making.

A key component to establishing an effective multidimensional learning environment is purposeful management. A technologically competent teacher plans an instructionally sound rotation schedule that addresses what students will do before they go to the computer, while they are at a computer, after they finish computer work, and what they can do at any point during the lesson. Another important aspect of the teacher-as-manager is the ability of the technologically competent teacher to actively solve problems. In a classroom that embeds technology into the instruction, the teacher must be adept at finding solutions to the ever-occurring technical problems that come with using any form of electronics.

References

Duffy, T.M. & Jonassen, D.H. (1991). Constructivism: New implications for instructional technology? *Educational Technology, 31*(5), 7–12.

Durham, P., Morrison, G. R., & Ross, S. M. (1995). Technology training of 21st Century Classroom Teachers. *Tennessee Educational Leadership*, 22, 41–45.

Gorrell, J. & Capron, E. (1990). Cognitive modeling and self-efficacy: Effects on preservice teachers' learning of teaching strategies. *Journal of Teacher Education, 41*(2), 15–22.

Kemp, J. E., Morrison, G.R. & Ross, S. M. (1994). *Designing Effective Instruction*. Merrill: New York.

Morrison, G. R. (1995). *Multidimensional Learning Environments*. Unpublished manuscript.

Focus

Technology Training for Teachers

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Key Words: **training, education, technology, integration, assessment, center**

The State of Georgia has committed to providing teachers with the appropriate resources for successful implementation of technology into today's classroom. Panelists will share the successes and learning experiences regarding the State training and support initiative for K–12 schools. Lottery funding has assisted in the success of the technology initiative by providing funding for classroom computers, software, media center automation and wiring retrofitting to name a few. Also, discussion will include experiences with the Kennesaw State College School of Education and the process involved in restructuring pre-service curriculum to instruct new teachers on the changing classroom environment and how technology will play a key role.

In 1993, the Georgia Department of Education implemented the Educational Technology Centers to provide pre-service and in-service training for educators. Each Center is provided with Macintosh, *Windows*, and Distance Learning training labs.

The following are list of the services that are provided by the Centers:

- Custom Staff Development Planning and Consulting
- Custom Training
- Technology Integration
- Technology Support after Training
- Consulting and Purchasing Support after Training
- School Technology Plans
- Team Building
- Network Consulting
- Electronic Portfolio Assessment
- Lesson Plan Development

All 15 Educational Technology Centers distribute trimester course catalogs to local schools. All training is free of charge with the exception of an occasional materials fee charge. School educators and administrators register for classes that are offered in both day and night sessions.

Individual school systems were given Technology Specialists for the 1995–96 school year for the purpose of supporting technology within school clusters. During the summer of 1995, the Technology Specialists participated in the "Technology Specialist Leadership Institute" which was designed by the DOE Technology Training Center Directors and DOE staff to offer a full technology staff development program for Georgia educators. The Technology Specialists will have the responsibility of supporting their local school hardware, software and networking needs. In conjunction with the Educational Technology Centers, the school Technology Specialists will assist in the "Train the Trainer" model in order to reach the vast number of teachers in the State.

In closing, the main goal of the focus session is to pass along to all educators that technology training and support can provide a valuable resource for teachers and in turn bring the world of technology to our children's classrooms. We feel that Georgia is on the right track in meeting these goals and objectives.

Paper
Cognitive Style and Achievement in Imperative and Functional Programming Language Courses

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Key Words: **learning style, programming paradigms, Kolb Learning Style Inventory, achievement, behaviorism, Scheme, C**

Abstract

We investigated the relationship between learning style and programming achievement in two paradigms: imperative (C) and functional (Scheme). Learning style was measured by the Kolb LSI; achievement was measured by programming course grades. Success in one course highly correlated with success in the other, regardless of language used. Though difficult to discern from this larger effect, small effects from learning style were enough to suggest further research.

Background

> The development of programming languages and methods, and the teaching of them, have up to now hardly been linked to a psychological study of the activity of programming, and this can account for certain failures...psychology must go beyond the procedural aspect of programming; it must take into account those other styles which, even if they are not new, are becoming more and more important nowadays due to the variety of applications and the training that programmers receive (Hoc et al., 1990).

Teaching programming is a challenge given the variety of languages used and the controversies surrounding their appropriateness for education. Study of the language-learning process is necessary to understand how the process can be improved. In this study, the possible connection between learning style and achievement in two programming styles is explored.

Theories of Learning Styles

Much educational and psychological research has been devoted to learning styles. Some troubles in teaching have been attributed to a mismatch between the structure of schooling and the peculiarities of how an individual learns. Studies have shown that students with particular learning styles perform better in different environments (Dunn et al., 1989). Wu (1993) states, "Individual styles ... not only result in preferences for different modes of presentation of learning materials and of analogies, but also lead to individual differences in the organization of semantic knowledge."

Learning style is a nebulous concept; definitions range from the simple, "how a student learns and likes to learn" (Keefe, 1988), to the precise notion of a...

> ... composite of characteristic cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment. It is demonstrated in that pattern of behavior and performance by which an individual approaches educational experiences. Its basis lies in the structure of neural organization and personality (Keefe, 1988).

Early learning style theories, based on behaviorism, shifted from the simple stimulus/response model to internal cognitive factors. Jung influenced the theory, classifying people into four types: thinkers, feelers, sensors, and intuitors (Bokoros et al., 1992). Later work in the 1970s, by Gregorc, identified four learning characteristics: concrete, abstract, sequential, and random. He paired these, ending up with four learning style types (AASA, 1991).

Kolb developed a model of learning also based on four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Within each stage people learn respectively by feeling, observing, thinking, and doing. Scores on these scales can be used to find a single type describing a person's learning style: either accommodator, diverger, converger, and assimilator (Kolb, 1985).

Each type tends toward a certain kind of career, Kolb asserts. Convergers are "best at finding practical uses for ideas and theories." Divergers see situations from many points of view, and are good at idea-generation and imagination. Assimilators are logical, working well with abstract ideas. Accommodators prefer working with people and learning from experiences. These learning styles have implications for tailoring education to the needs of the student (Almstrum and Wu 1993).

Computer Programming Paradigms

An *imperative language*, including C, Pascal, and FORTRAN, "achieves its effect by changing the value of variables by means of assignment statements" (Wilson & Clark, 1993). These commands update variables held in storage (the Latin "imperare" means "to command"), a process known as "side-effect." Imperative languages use sequence, selection, and iteration, making them very efficient for execution of programs on von Neumann architecture. This is true especially of C, a high-level language, designed to behave like a low-level language for flexibility and efficiency (Wilson & Clark, 1993).

Functional languages, such as LISP and its derivative Scheme, rely on evaluation of expressions rather than side-effects. The input-to-output conversion simply uses expressions, functions, and declarations without variables; though some functional languages (e.g., Scheme) rely on side effects for certain functions. Such programs are controlled recursively rather than iteratively.

While there are other paradigms (e.g., logic and object-oriented), imperative and functional languages (respectively, C and Scheme) are the focus of this study.

Learning Styles and Computer Programming

Programming aptitude has been measured (e.g., an IBM test focused on general verbal and spatial abilities and mathematical reasoning); but it is unclear how well this predicts performance in programming tasks (Palormo, 1964; Tromp, 1989). There are relations between mathematical (e.g., measured by the SAT) and programming ability, but they largely disappear after factoring out general ability (Tromp, 1989). As recently as the 1970s, aptitude for programming jobs was assessed by these tests (Luftig, 1975); nowadays, however, an understanding of how people learn different computational models is necessary to accommodate the present diversity of languages.

There is a need for investigating how the ways people learn, not just aptitude, may influence productivity in various programming languages (Hoc et al., 1990).

> There are many ways to do research on programmers, but the discipline of controlled psychologically-oriented experiments produces reliable and authoritative results....A major research project to investigate the impact of programming language design on productivity and error rates and to develop an understanding of the cognitive processes in programming could have a dramatic influence on future programming languages (Soloway & Iyengar, 1986).

Indeed, once we better understand how people learn to program and fare in different programming environments, new languages could be designed to make better use of human abilities.

Mayer has suggested that difficulties some students have is that learning programming involves a great deal of precision-intensive problem solving. In some cases, the students have what he calls a "fragile knowledge of domain": students have trouble applying their

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own knowledge effectively to the problem at hand. There are also problems with confidence in abilities and feelings of control or mastery; and he has found that a structured approach works better than letting students discover concepts on their own (Mayer, 1988).

Van Merrienboer explored more directly the relationship between learning style and success in programming with two studies on the specific reflection-impulsivity cognitive style dimension. Reflectives tend to spend more time examining problems, while impulsives prefer to jump into the middle and are less systematic in gathering information. He found that the reflectives performed better at comprehension of programs; and so he investigated ways to get impulsives to move to a more reflective strategy. Having impulsives do coding assignments that require the generation of new programs is more effective, while reflectives benefit from completing partial programs (van Merrienboer, 1988, 1990).

Kagan found a link between personality and achievement in programming: "Significant correlations obtained between personality scales and achievement were computed *after* variance attributable to inherent aptitude was removed" (Kagan, 1988). She also found "among both males and females, achievement in FORTRAN was significantly related to a tendency to organize information analytically"; and she noticed a tendency of successful students to be "compulsive," "perfectionist," and "attentive to detail" (Kagan, 1988).

Two of Piaget's stages, concrete operational and formal operational, were the subject of a study conducted by Hudak and Anderson. They investigated whether level of cognitive development and learning style, as measured by the Kolb, were related to success in Statistics and Computer Science (CS) courses. Hypotheses were confirmed that people with more cognitive development, having reached the formal operational stage, would have the tools needed to understand those concepts and that more abstract learning styles helped with achievement (Hudak & Anderson, 1990).

Foreman found correlations between program understanding and the cognitive characteristics of field independence, reasoning, and direction following: "alternate instructional approaches would help different cognitive styles and aptitudes, to learn programming skills more quickly and effectively" (Foreman, 1990).

In other studies, word problem and algebra skills aided in computer programming but group learning of programming did not differ from individual learning (Shute, 1991; Webb et al., 1986).

The present study is perhaps closest in spirit to Wu's in which cognitive learning style, as described by Kolb, was correlated with novice learning of recursion. That study demonstrated that "novice programmers with abstract learning styles performed better than those with concrete learning styles when learning recursion" (Wu, 1993); the concrete conceptual model was likened to a "glass box," the abstract conceptual model to a "black box," with respect to awareness of the underlying machine.

Thus, in the present study, certain results could be anticipated. Since programming in the functional language Scheme is replete with recursion (and black-box functionality), one would expect success to be associated with an abstract learning style. And the closeness of the procedural C language to the von Neumann machine ("glass box") would suggest correlation with a concrete learning style.

Procedure

Subjects

Subjects were undergraduate CS students at Trinity University, a small private liberal arts institution in Texas. Most were sophomores or juniors; most had taken introductory CS courses at Trinity. Thirty-two subjects were selected from the courses in Functional Language Programming, Assembly Language Programming, and Formal Languages, giving a range both in age and background. All students were assumed to have taken CS 311–312 (Problem Solving and Algorithm Design I, II) and CS 316 (Functional Language Programming).

Method

Each subject received a packet containing a consent form, a sheet for grades, and a copy of the Kolb LSI for self-administration. The grade sheet was to be used for confidentially recording grades in three courses: CS 311–312 (C) and CS 316 (Scheme). The advisor for this project recorded grades and removed the consent forms before data were transferred to the student researcher; thus the data were anonymous.

Means and standard deviations of grades were calculated for each course, and grades for each student were standardized into a 4.0 scale (by subtracting the class mean from each grade and dividing by the standard deviation) to facilitate comparison across classes. Scores from the Kolb LSI were translated to percentiles. The resulting standardized numbers were used as data points in the statistical analysis. Course grades were collected for three classes, CS 311, CS 312, and CS 316, but only grades in CS 312 and CS 316 were used in the analysis. CS 311 grades were deleted for three reasons:

1. Students in CS 312 and 316 would have prior experience in programming, CS 311 students might not.
2. Some students in CS 311 had been taught with Pascal, others with C; they were not distinguished in the data collection.
3. Many students had not taken CS 311 (e.g., by AP credit).

Statistical Analysis

The data on grades and learning style were analyzed using a linear regression model, chosen over more sophisticated models due to the small sample size. The data were plotted in all combinations of the CS courses with each of the four learning styles, giving twelve plots, each only mildly linear. The grades for the second introductory CS class were plotted against those of the functional language course, giving a more distinct linear pattern.

C statistics were calculated for all possible combinations of independent variables in two separate models (SAS notation) where learning style scores are RO (reflective observation), CE (concrete experience), AC (abstract conceptualization), and AE (active experimentation):

1. CS312 = RO CE AC AE CS316
2. CS316 = RO CE AC AE CS312.

The C statistic, a function of the error in the model, provides a way to compare different models in terms of their explanatory value, taking into consideration how many variables are in the model. More variables on the right-hand side may help the model explain more variance in the left-hand variable, but some do little to help and should be dropped. In general, the simpler the model, the better (Bowerman and O'Connell, 1990).

For the first model, the combination of independent variables with the optimal combination of R^2 and the C statistic was RO and CS 316. In the second model, the best combination was CE and CS 312. Stepwise regressions yielded similar results, although in model 1, RO did not meet the entry significance level. Stepwise regression involves performing several regression models in succession with different sets of independent variables; variables are added if they add significantly to the model and variables are removed that do not meet the significance level. The final model from a stepwise regression is the "best" combination of independent variables, based on how much they contribute to the overall model (Bowerman and O'Connell, 1990).

Regular linear regressions were run on the independent variables suggested by the above tests. In both cases the overall models were statistically significant, with p-values below .04. The p-values for t-tests for individual coefficients were higher, though; and only the grades from CS 312 and CS 316 were significant at the .05 level. P-values measure the probability that the statistics indicate that a variable or model is significant, when it in fact is not significant. Lower p-values indicate increased confidence in the model.

Models were rûn including all 5 independent variables plus interaction terms: the 6 possible combinations of pairs of learning style dimensions (RO, CE, AC, AE). The overall significance of the models dropped considerably; in fact, both models had p-values for the overall F-test above .5. Partial F-tests were done for both to see if the interactions and three additional learning style dimensions should be dropped. In all four cases, the answer was a resounding yes, with p-values above .8.

More tests were run with the earlier models that included two independent variables. Residual plots showed appropriately distributions, although in one case (RESID1*RO) the variance was not constant. Residual plots show the error values (differences between actual and predicted values for the independent variable) for each model. There should be no discernible pattern in the errors, since otherwise, that would mean there were more that is not explained by our model. The stem-and-leaf plot, box plot, and normal probability plot do not indicate any violations of the regression assumptions for model 1. However, the stem-and-leaf plot for model 2 is top-heavy. The box plots appear reasonable, though. The above three plots are used to check whether the data are normally distributed, which is one of the predictions of the regression model (Bowerman and O'Connell, 1990).

Based upon these analyses, the best two models appear to be (in SAS notation):

1. CS312 = RO CS316
2. CS316 = CE CS312.

Within this model, the results indicate that grades in one course are the best single predictor of performance in the other. However, there may be an additional effect from learning style. Though it is not nearly as strong, scores on two of the dimensions of the Kolb LSI predict some of the variance in grades in CS 312 and CS 316.

Conclusions

General ability in programming proved much stronger an effect than learning style on success in programming courses, regardless of the language. Yet learning style did contribute some predictive value to the models. Also, different learning styles were more significant predictors in one language than another; high scores on the RO (reflective-observation) scale of the Kolb were associated with higher grades in CS 312. The RO scale measures a person's tendency to patiently observe and act carefully; this might be associated with success in C since the syntax of C programs is complex and coding requires careful work (and patience).

The CE (concrete-experience) scale was associated with skill in CS 316. People with high scores on CE tend to be open-minded and adaptable to change. Since programming in Scheme is so different from the procedural languages many students first encounter, that openness may help with readily accepting a new paradigm. In addition, functional languages are also called applicative languages, since functions are directly applied to data. This directness may help to illuminate the structure particularly well for someone who has high scores on the CE scale of the Kolb.

We see here, then, results that differ from those that were earlier anticipated along the lines of Wu's study (1993). Here success in the procedural language C was associated with a RO cognitive style, not with a concrete style. Indeed, in the present study, a CE cognitive style was correlated with success in the functional language! Perhaps the comprehensive rigors of learning an entire language are not at all comparable to learning a specific aspect of that (or any) language—e.g., recursion, as in Wu's study. The above speculative comments may serve to illuminate these points; but certainly we can see the desirability of further research into these relationships.

That a learning style effect is difficult to separate from general ability should not leave us discouraged. The fact that such an effect exists should motivate more research into this question, since it provides a possible way to make CS education more effective for novices.

As this is a relatively unexplored area, there is ample room for more studies. Acknowledging limitations in the present study and suggesting alternate strategies should prove useful to those planning further work in this arena. One limitation of this study was the lack of a large student pool. A larger-scale study would be necessary before many conclusions could be drawn. Or, especially given a small N, it would be desirable to determine the subjects' subjective assessment or preference for programming language in addition to the objective measure of grades. And programming paradigms other than imperative and functional should be considered in future studies.

An orientation toward expert subjects rather than the novices here might be especially fruitful: bypass students altogether and test faculty. Ideally students would be studied who, with no prior programming experience, would see either an imperative or a functional language *as their first experience*. Such are increasingly difficult to find as many college students have had prior programming (usually with an imperative language). Many faculty, on the other hand, who teach programming classes have strong preferences for which language is "best" as a first one for novices. Testing learning styles and relating them to *preferred* languages might yield interesting results. Presumably the bias inherent in their own first exposure would be eliminated or reduced by years of experience and consideration given to this issue, especially if the subjects had taught both styles. Then, of course, the study would not be about which is more suitable for students based on students' cognitive style, but rather, what do experts tend to recommend based on their own cognitive style? And ... do the same cognitive styles influence novices and experts in the same ways?

Bibliography

Almstrum, Vicki L. and Cheng-Chih Wu. "The CSedRes Toolbox: A Resource to Support Research in Computer Science Education." *SIGCSE Bulletin*, 25, No. 4 (1993), 21–26.

AASA (American Association of School Administrators), *Learning Styles: Putting Research and Common Sense into Practice*, Arlington, VA, 1991.

Bokoros, Michael A., Marc B. Goldstein, and Mary M. Sweeney. "Common Factors in Five Measures of Cognitive Style." *Current Psychology: Research and Reviews*, 11, No. 2 (1992), 99–109.

Bowerman, Bruce L. and Richard T. O'Connell. *Linear Statistical Models: An Applied Approach*. Boston: PWS-KENT Publishing Company, 1990.

Dunn, Rita, Mary Cecilia Giannitti, John B. Murray, Ino Rossi, Gene Geisert, and Peter Quinn. "Grouping Students for Instruction: Effects of Learning Style on Achievement and Attitudes." *The Journal of Social Psychology*, 130, No. 4 (1989), 485–494.

Foreman, Kim H. "Cognitive Characteristics and Initial Acquisition of Computer Programming Competence." *School of Educational Review*, 2 (1990), 55–61.

Hoc, J.-M, T.R.G. Green, R. Samurçay, and D.J. Gilmore, eds. *Psychology of Programming*. London: Academic Press, 1990.

Hudak, Mary A. and David E. Anderson. "Formal Operations and Learning Style Predict Success in Statistics and Computer Science Courses." *Teaching of Psychology*, 17, No. 4 (1990), 231–234.

Kagan, Dona M. "Learning How to Program or Use Computers: A Review of Six Applied Studies." *Educational Technology*, 28, No. 3 (1988), 49–51.

Keefe, James W., ed. *Profiling and Using Learning Style*. Reston, VA: National Association of Secondary School Principals, 1988.

Kolb, David. *Learning Style Inventory*. Boston: McBer and Company, 1985.

Luftig, Milton. *Computer Programmer: The Complete ARCO Test-Tutor*. New York: ARCO, 1975.

Mayer, Richard E., ed. *Teaching and Learning Computer Programming: Multiple Research Perspectives*. Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers, 1988.

Munsinger, Brita. *Learning Style and Achievement in Imperative and Functional Programming Language Courses*. San Antonio, Texas: Trinity University Senior Thesis, 1995.

Palormo, Jean Maier. *Computer Programmer Aptitude Battery*. Chicago, IL: Science Research Associates, Inc., 1964.

Shute, Valerie J. "Who is Likely to Acquire Programming Skills?" *Journal of Educational Computing Research*, 7, No. 1 (1991), 1–24.

Soloway, Elliot and Sitharama Iyengar, eds. *Empirical Studies of Programmers*. Norwood, NJ: Ablex Publishing Corporation, 1986.

Tromp, Th. J. M. *The Acquisition of Expertise in Computer Programming*. Amsterdam: Uitgeverij Thesis, 1989.

van Merrienboer, Jeroen J. G. "Instructional Strategies for Teaching Computer Programming: Interactions with the Cognitive Style Reflection-Impulsivity." *Journal of Research on Computing in Education*, 23, No. 1 (1990), 45–53.

van Merrienboer, Jeroen J. G. "Relationship Between Cognitive Learning Style and Achievement in an Introductory Computer Programming Course." *Journal of Research on Computing in Education*, *21*, No. 2 (1988), 181–186.

Webb, Noreen M., Philip Ender, and Scott Lewis. "Problem Solving Strategies and Group Processes in Small Groups Learning Computer Programming." *American Educational Research Journal*, 23, No. 2 (1986), 243–261.

Wilson, Leslie B. and Robert G. Clark. *Comparative Programming Languages*. Wokingham, England: Addison-Wesley Publishing Company, 1993.

Wu, Cl[illegible]g-Chih. *Conceptual Models and Individual Cognitive Learning Styles in Teaching Recursion to Novices*. Austin, TX: University of Texas at Austin Doctoral Dissertation, 1993.

Focus
Introducing Print-Oriented Teachers to Online Services

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Key Words: **online services, teacher training, curriculum integration, telecommunications, Kidsnet, America Online, Scholastic Network**

In this focus session we will share our experiences in developing the use of online services for a print-oriented staff in the Manchester, New Hampshire School Department. National Geographic's Kidsnet, America Online, and Scholastic Network were chosen because of their direct connection to the district's curriculum.

With online technology changing and expanding so rapidly, we needed to provide our staff with extensive and intensive training. In a district with 22 schools, 1,200 staff members, and 16,000 students we faced and confronted these issues:

- How do we fund and procure equipment for this effort?
- How do we provide equitable access to staff, and eventually students?
- How do we effectively train staff? What staff is initially trained?
- How did we overcome staff resistance to the new technology of online services?
- What are the direct connections of online services to the curriculum?
- How do online services directly impact students?
- How do we evaluate the overall value of online services in the schools?

The introduction of online services in the Manchester School District is a continually evolving process involving hard work, creativity, and experimentation. There have been successes and failures, yet the total response to the value of online services has been overwhelmingly positive.

Focus

Digital Portfolios: Looking at a Richer Picture of Student Achievement

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Key Words: assessment, multimedia, hypermedia, school reform, portfolios

You can probably imagine that we in schools can develop a richer picture of student achievement through multimedia tools than through traditional paper transcripts or report cards. But what does that picture reveal? How do schools gather and report that information? How can other audiences, from parents to college admissions officers, to state departments, use these pictures?

The Coalition of Essential Schools, through a project funded by IBM, has conducted research on these questions. Using *Digital Portfolio* software developed specifically for this research project, students at six sites (Eastern High School in Louisville, KY; Thayer High School in Winchester, NH; University Heights High School in the Bronx, NY; and the three schools of the Croton-Harmon School District in Croton-on-Hudson, NY: Carrie E. Tompkins Elementary School, Pierre van Cortlandt Middle School, and Croton-Harmon High School) have created multimedia collections of their work, along with associated information (such as assignments and evaluations). In this panel presentation, we will describe the systems that have emerged in each of these sites to make *Digital Portfolios* possible, and how the various audiences, both inside and outside of the school, have worked with these portfolios.

Putting a *Digital Portfolio* system in place requires the examination of the technological system, the logistics of the school, the assessment system, and the culture of the school. Our panelists can speak to the technological issues of wiring schools and putting student information on the network, and how they have creatively used time, space, and other resources to make *Digital Portfolios* possible. Beyond addressing the technological system and the logistics, the more difficult issues schools face are in determining how *Digital Portfolios* will become part of the school's assessment process, and how teachers, students, parents, and others have to modify their culture of communication in order to make the reviews of the *Digital Portfolio* meaningful.

The schools brought a variety of experiences to this project, and it has taken a different shape in each school setting. At Eastern High School, for example, students take primary responsibility both for selecting their work and for providing technical support (through a "digital portfolio staff" similar to a yearbook or newspaper staff); there, the project has grown from a pilot of a few students to an effort involving all 1600 students. The Croton-Harmon School District involved discussions from K through 12 on what belongs in a portfolio, and who decides what entries should be put in a portfolio. (Students at Pierre van Cortlandt Middle School had previously been developing an electronic portfolio as a cumulative event at the end of the eighth grade; the NECC '95 program included a presentation on that project by panelists Dean vandeCarr and Jan Felt). Thayer High School, which serves a smaller, rural community, and University Heights High School, a public school in New York City, have each used the *Digital Portfolio* to enhance existing portfolio mechanisms—and to reflect on what those existing portfolios have meant for students, teachers, and other readers of that information. At those schools, an ongoing conversation about assessment took new turns because of the possibilities that the *Digital Portfolio* represents.

Panelists from the Coalition will also talk about the future of this endeavor, including emerging conversations with colleges and universities about the use of *Digital Portfolios* in the admissions process.

While very much a work in progress, we have seen already that the *Digital Portfolio* can provoke school reform conversations. Taken seriously, the *Digital Portfolio* can be more than just an interesting activity for students to use multimedia; it can be the starting point for conversations about a vision of what students should know and be able to do, and for creating a process where a school helps all students to meet that vision.

Focus

Project CROAK! (Creeks, Rivers, Oceans, and Kids!)

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Key Words: **elementary, environment, water, wildlife, technology, writing, collaboration**

Project CROAK! uses the vehicle of a fictitious frog to travel the nation's waterways and teach young children the importance of environmental sensitivity. Students use manipulative software to construct multimedia presentations about their portion of an interconnected waterway, and they publish creative writing stories about how their frog got from one partner school to the next. The project is an interactive and collaborative activity that is easily replicated.

Project CROAK! addresses the problem that elementary students are not adequately exposed to the interdependent relationships that are established between their own behaviors and the state of the environment. There has been little research conducted on the cognitive understanding of young children as it applies to environmental and ecological issues. The reasons for this are: 1) in modern Western society children have few direct experiences with living things or with complete chains of physical systems; and 2) there is a lack of instructional activities that focus on environmental "common denominators" which serve to link children together in collaborative and interdependent ways. Instruction for elementary students must concern itself with the systematic, connecting relationships that exist between the environment and natural resources; the environment and other students; and the environment and other topics of study. The project also addresses the problem that environmental issues are too often associated solely with the science curriculum. During the early elementary school years students are developing lifelong attitudes about science and the environment. The need to integrate environmental issues into every aspect of the curriculum will result in students who are more aware of environmental problems and who are more likely to take on the tasks of ownership and empowerment as they apply to environmental issues.

The purpose of Project CROAK! is to develop more environmentally-sensitive children so that they will someday become environmentally-sensitive adults. This is done by allowing third grade students from different states the freedom to form collaborative partnerships with each other. By providing curricular vehicles that link each school and cause the participants to be dependent upon one another for information, Project CROAK! stresses that true environmental preservation efforts come about in the same interdependent way. Students come to understand that environmental issues affect everyone, and that solutions to environmental problems must be the work of every citizen.

Project CROAK! includes schools along a river route system that leads from Buck Creek near Douglas MacArthur Elementary School, to the White, Wabash, and Ohio Rivers, into the Mississippi River, and out into the Gulf of Mexico. Much of the affected area is impoverished due to either rural or inner-city isolation. The project, therefore, is conducted in hard-to-reach areas where opportunities for environmental education are limited. All project participants use manipulative and multimedia software, as well as some type of word processing software. The relationships established between schools depends upon the mastery of this technology and the students' use of their creative thinking skills.

Each September a group of tadpoles are raised in the man-made pond at Douglas MacArthur Elementary in Indianapolis, Indiana. Over the course of one month, as the tadpoles develop into frogs, a fictitious event takes place. One of the frogs, Mac, escapes from the pond and starts a waterway adventure beginning from nearby Buck Creek and terminating in the Gulf of Mexico. Third grade students at Douglas MacArthur begin a search for the frog with the understanding that amphibious animals do not stray far from water. Therefore, the search is limited to associated water routes and involves partner schools located along these water routes.

In October, the collaborative part of the project begins. Douglas MacArthur students produce an introductory multimedia presentation on a floppy disk. The presentation explains to other partner schools that Mac the Frog has run away. The disk features digitized images of Mac in a mugshot array and describes his home environment of the man-made pond. It also includes information about Buck Creek and the White River, including sources of water pollution and other environmental hazards, wildlife, geography, water quality, and other pertinent information. Students explain that they are tracing Mac's probable route of travel along interconnecting waterways, and that they are looking for partner schools to join in the search. Douglas MacArthur students also enclose the first chapter of a creative story about Mac the Frog. The story begins with a biography of Mac, then highlights his life up to the time of his escape.

The activities selected for this project, those of interdependence and collaboration, are designed so that young children may discover the value of cooperative relationships at an early age. By teaching children that water pollution effects entire systems of animal and plant life in a cause-and-effect manner, the project sends the message that it takes environmental awareness of individuals both upstream and downstream to stop water pollution in the very same way. Students begin to feel ownership of their waterway as they gain more knowledge. They begin to feel empowerment for environmental preservation as they communicate with students of common purpose. In making each partner school a link in a chain of environmental and creative activities, the project enhances the students' sense of responsibility to complete assigned tasks. Project CROAK! creates an awareness in young students' minds that their behavior and attitude regarding the environment is directly related to the state of the environment.

Focus

Study American History, Study Your History (Focus Session)

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Key Words: curriculum integration, history, genealogy, immigration, language arts

The study of history to many students is the study of the dead past. These students do not understand and appreciate the struggles of their ancestors. Thus there is no understanding of the dynamics that continue to shape their lives today.

Innovative and integrated language arts and social studies curricular units allow students to gain a much greater appreciation of both their own history and American History. These units can combine computer simulation, multimedia, video, research (on and offline), writing, speaking, and reenactment.

The first of three units involves an immigration/genealogy unit to be undertaken in language arts while history class covers exploration and colonization. While the students study American history they simultaneously study their own history and that of their family—their roots. The intent is to instill in them pride in their American heritage and also in their ancestral, national heritage. Hopefully they will understand their nation and its composition better, and also have a greater appreciation for who they are.

The students begin with genealogy study which includes first and second generation interviews and investigations into the student's own ancestry. The use of computerized genealogy programs is encouraged. Students later present the results of their research to their classmates.

A study of the immigration patterns of the mid-19th Century also begins. For an assortment of reasons all students are not able to research their own history; however, they can become honorary Irish. Students use a version of the Harvard E.T.C. *Irish Immigrant Adventure* updated for *ClarisWorks*. (The update is shown in this presentation.) Students use a multimedia presentation on the Irish immigrants, and write a journal from the perspective of their adopted Irish family. Students must research living conditions, costs, historical events, etc. to make the experiences of their journal family historically accurate. More capable students are encouraged to create a multimedia journal.

For many students, their own ancestry research takes them to Ellis Island. The culminating activity of this unit is a reenactment of the Ellis Island experience. Reflective writing is used by the students to evaluate their feelings and insights obtained during the simulation. A student created multimedia presentation is included in this focus session that includes video clips of several genealogy presentations and the Ellis Island reenactment, and excerpts from their Irish Immigrant Journals and their reflective writings.

Although this unit ends after the Ellis Island reenactment, the saga of their Irish Immigrant (and their own family history) will continue in the final unit of the year, the Civil War. A part of this integrated curricular unit, the history includes an investigation of the Irish Brigades, beginning with the recent discovery of the grave of several unidentified soldiers at the Antietam battlefield. Students follow the archeologists through artifacts, Civil War records, and investigations until the soldiers are identified as probably belonging to one of the Irish Brigades. The possible adventures of the student's Irish immigrant and descendants will be written about. If the student's own ancestry can be traced to the American Civil War, that, too, will be included.

As part of the integrated curricular approach, students are required to read a book relevant to the units (i.e. about immigration for the initial unit, about the Civil War for the concluding unit). Many students choose historical novels or biographies but some even choose historical texts or classics from the era being studied.

The integrated curriculum using various media, computer and reenacted simulations, reading, research, and writing helps students gain a much greater appreciation of both their own history and American History.

An end-of-the-year trip to Ellis Island and several other sites (Gettysburg) that they have studied will be a culminating event for many of the students.

Paper

Increasing Reflective Instructional Decision Making by Clinically Supervising Teachers Using Telecommunications

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Key Words: **reflective decision making, clinical supervision, improvement of instruction**

Abstract

Clinical supervision is a commonly accepted model used by supervisors of local school district teachers. The clinical supervision model is also used with pre-service teachers and has been enhanced by the use of e-mail and the Internet. What has been learned with pre-service teachers can be applied to local school districts. With telecommunications, greater opportunities are provided for teacher reflective decision making, formative feedback from supervisors, joint supervisor and teacher problem solving, acquisition of lesson plans and student project ideas from numerous sources, and the improvement of instruction.

Introduction

Clinical supervision began at Harvard University with pre-service intern teachers and was described by Morris Cogan in 1973.[1] K–12 teachers and supervisors are familiar with the steps in the clinical supervision process: preconference, observation, analysis and interpretation of the observation, postconference, and critique of the process.[2] Clinical supervision is time intensive, but it is the most commonly accepted method of observing teachers in K–12 school districts[3]. In this model, the primary purpose of supervision is grounded in the notion that instruction improves[4] as the teacher critically examines the teaching learning process and applies what has been learned to the teaching process. As school districts advance technologically, it is quite possible to extend the use of telecommunications and/or e-mail to the clinical supervision process. Telecommunications and/or e-mail is not expensive and more frequent observations can be done with the expectation that the frequent feedback will improve teacher satisfaction (Dornbush and Scott[5] and Natriello[6]).

Using E-Mail and the Internet with the Pre-Service Teacher

Schools of Education at Harvard University, the University of Virginia and the University of Kansas, among others, have initiated clinical supervision projects using e-mail and the Internet, and have also created problem-solving networks open to preservice teachers, beginning teachers, cooperating teachers and college supervisors.[7] During the 1994–1995 academic year, the authors were involved in a 16-week pilot project designed to allow triads of college supervisors, student teachers and cooperating teachers to communicate frequently using the William Paterson College e-mail and Internet access system and Mac PowerBooks.

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[1]. Cogan, M. (1973). Clinical supervision. Boston: Houghton Mifflin.

[2]. Goldhammer, R., Anderson, R.H. and Krajewski, R.J. (1993). *Clinical supervision: Special methods for the supervision of teachers*. Fort Worth, TX.: Harcourt Brace Jovanovich.

[3]. Glickman, C., Gordon, Sp., & Ross-Gordon, J.M. (1995). *Supervision of Instruction*. Boston, MA: Allyn & Bacon.

[4]. Nolan, J. & Francis, P. (1992). "Changing perspectives in curriculum and instruction." in Glickman, C. D. (Ed). *Supervision in transition*. Washington: ASCD

[5]. Dornbush, S.M., Scott, W.R. (1975). *Evaluation and the exercise of authority*. San Francisco: Jossey-Bass.

[6]. Natriello, G. (1982). *The impact of the evaluation of teaching on teacher effect and effectiveness*. Paper presented at the annual meeting of American Educational Research Association, New York, March.

Each triad, consisting of a college supervisor, a student teacher, and the student teacher's cooperating teacher, was given two Mac PowerBooks paid for through a William Paterson College-funded program improvement grant.[8] Printers were not included with the equipment distributed. The college supervisor used one PowerBook and the student teacher and cooperating teacher shared another. Two training sessions were held prior to the start of the project and all of the participants received instruction on the use of the equipment. At a later date, a third training session was held to enable the participants to access the resources of the Internet. A final session was held to evaluate the project using feedback from all of the participants.

Both successes and failures occurred. The failures of the project related to two variables. If the triad experienced equipment problems and were unable to effectively use the equipment to communicate, the originally designed process failed. The second and the more important variable was the initial competence level of the student teacher. If the student teacher lacked entry level skills to teach successfully communicating about the problems experienced was very threatening. In one case the student teacher had so many problems that the cooperating teacher and the college supervisor decided to stop the project and substitute a concentration of intensive direct assistance strategies.[9]

The successes of the William Paterson project occurred when the college supervisor used clinical supervision strategies with a student teacher. Clinical supervision is not always the norm when student teachers are supervised. College supervisors are often separated from the student teacher by large geographic distances and communication prior to a lesson is frequently limited. Sometimes the college supervisor and the cooperating teacher provide different feedback to the student teacher. When the college supervisor and the cooperating teacher used the clinical supervision process, the feedback to the student teacher was less confusing. All commented that the opportunities for problem solving and for sharing what had been learned increased dramatically as the project progressed. That result may have occurred because the individuals had to type their responses and send those responses through e-mail. Not only does writing often help to crystallize what is learned, a common set of experiences and expectations for reactions is shared by all.

Using Telecommunications and/or E-Mail with the In-Service Teacher

While the student teacher experience in the college and university setting is different from the employed teacher's experience in the K–12 setting, some of what was learned in the William Paterson example can be transferred to the K–12 setting for use by the in-service teacher and supervisor.

Commonly non-tenured teachers are formally observed a maximum of three times during the school year. Tenured teachers may be observed once or twice a year, and in some school districts, teachers identified as outstanding are not observed. While the teachers usually wish to be observed more often, the supervisor usually cannot find enough time to do more. If telecommunications and/or e-mail is used, the frequency of observations can be increased. Part of the time problem—i.e., finding the time and arranging for the preconference—can be eliminated by using a computer and a modem to communicate.

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[7]. Ellsworth, J. (1994). *Education on the Internet*. Indianapolis, IN.: Sams Publishing.

[8]. Seminoff, N., Wepner, S. (1994) Professional Improvement Program, Grant Proposal, Wayne, NJ: William Paterson College. June.

[9]. Glickman, C.D., and Bey, T.M. (1990) "Research on supervision in teacher education." in R. Houston (Ed.), *Handbook of research on teacher education*. New York: Macmillan.

The teacher can easily share a lesson plan with the supervisor several times before the lesson is actually taught. Without telecommunications and/or e-mail, the teacher and the supervisor may meet and discuss the lesson in a preconference, but the supervisor may not have the opportunity to schedule a second conference to give reactions to the teacher's revisions of the lesson plan that stemmed from the discussion. With e-mail the supervisor and the teacher have the opportunity to share individual written responses to revisions as frequently as they wish before the lesson is taught. When the supervisor produces the final written observation, it can reflect not only what the supervisor wrote, but also what the teacher wrote. If a plan for improvement follows from the postconference, it can be written jointly.

Increasing Reflective Decision Making

A pre-service or an in-service teacher who has the opportunity to communicate regularly with a supervisor in a clinical supervision process will have an increased opportunity for reflective decision making. As Schulman[10] tells us, teachers need to learn from their experiences and they need to share those learnings with others. However, with the isolation of the teacher in a single classroom, the opportunity to share what is learned is almost impossible. The use of e-mail may solve a part of this problem. As the teachers and the supervisors become more proficient in the use of e-mail and as it is more readily available, local school district teachers may form networks or forums to provide opportunities for sharing what has been learned, new ideas and plans of action. Traditionally supervisors and principals used observations of teachers to make teachers aware of additional resources. Using e-mail, the supervisor or principal can tell teachers about existing chat groups for subject area school district teachers or all teachers in a particular state, nation or group of nations. Or, the teachers can share resources and ideas with other teachers, the supervisors and the principal.

Peer coaching[11] using e-mail is possible in school districts. In this situation, the communication can be done through the use of e-mail thereby eliminating the problems that often arise when teachers do not have regularly scheduled common planning periods. Extension of this idea to the mentoring of first year teachers is also possible.

School districts often rationally plan[12] a focus for instructional improvement during a given school year. Increasing the communication about what is learned during the school year is possible with the use of e-mail. Those learnings can be compiled into a report with suggested possibilities for further analysis and action in a subsequent school year. The report might be used in the same fashion that case studies are used in pre-service education.

Conclusion: Formative Versus Summative Evaluation

Clinical supervision is a formative type of evaluation. As the student teacher or the in-service teacher develop during the semester or the year, the emphasis is on growth, not summative judgments. At the end of the student teaching experience and/or the academic year, student teachers and in-service teachers are judged in a summative evaluation. If the same categories or foci are used in the summative evaluation that have been emphasized during the clinical supervision process, final evaluations should not be threatening to the evaluatee or gut wrenching for the evaluator.

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[10] Schulman, L. (1988) "Teaching alone, learning together, needed agendas for the new reforms", in Sergiovanni, T.J. & Moore, J. H. *Schooling for tomorrow: directing reforms to issues that count*. Boston, MA.: Allyn and Bacon.

[11] Gordon, S.P. (1990). Teacher directed peer clinical supervision: Participants' reactions and suggestions. Paper presented at the annual meeting of the American Educational Research Association, Boston, April.

[12] Hoy, W.K. & Tarter, C. J. (1995) *Administrators solving the problems of practice*. Boston: Allyn and Bacon.

Focus

Integrating Technology into the Higher Education Classroom

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Key Words: **multimedia classroom, higher education, integrating technology**

Classroom presentations in the academy have long been dominated by a single instructional strategy: lecture. Using this vehicle, professors eagerly share their accumulated knowledge with students. Student participation is usually limited to answering questions posed by the professor or infrequent questions to the professor about the information presented. However, students now attending colleges and universities are from the "light-trained" generation. They are not passive, quiet, and submissive; rather they require interaction, discussion, and movement. Most of these students are computer literate and, from previous experience, they know how to access, manage, and manipulate vast sources and amounts of data.

As colleges and universities acquire technology for use in the classroom, all college professors are challenged to integrate this technology into the learning experiences they create for their students. Using multi/hyper media presentation materials, computers, Web sites, LaserDisc players, CD-ROM players, video cameras, and QuickTake cameras in the college and university curriculum and classroom, a passive classroom can be transformed into a creative, active learning environment that invites activity, discussion, and collaboration and acknowledges the technological proficiency students bring to this learning environment. Assignments can be transmitted through e-mail allowing professors to provide immediate feedback to students. Online discussion groups provide an opportunity for professors and students to communicate about questions, assignments, readings, or research in progress.

The presenters will share their experiences and show a multimedia presentation with examples of integrated technological higher education classrooms in various disciplines. Comments from students who have been learners in this type of college course will be included. Successful professional development ideas will also be shared. Participants will receive a listing of written examples that specify forms of technology that can be used in the academy.

Focus

Developing Technology Rich Educational Environments

(Funded by Coca Cola Foundation)

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Key Words: **Georgia, teaching, staff development, higher education**

Rationale

Technology is expanding and changing at a rapid pace. In times of rapid change, experience becomes the worst enemy. People can no longer depend on the skills they developed twenty years ago or even five years ago. Keeping with the pace set by technology can be a difficult task and yet keeping up is essential, especially for teachers, and students. The education that students will need for tomorrow requires that teachers teach differently today.

In 1984, there were 125 students for every computer in schools. Today that number has been reduced to 14 students for every computer and computer use has increased seventy-seven percent during the last five years. In 1994, schools in this country invested $2.5 billion in technology (*PC Novice*, Sept. 1994). This financial investment must be supported by personnel with the skills to best utilize the available hardware and software. In addition, new modes of education must be incorporated into the curriculum. Online searches will replace fact delivery, primary sources will enrich textbooks, and CD-ROMs, LaserDiscs, and telecommunication will enhance paper sources.

The component that is most lacking in Georgia is in providing quality professional development opportunities for educators. It is important that higher education begin to collaborate with the primary and secondary educators to help change this situation. Today's preservice teachers need to be ready to deal with technology and college faculty must be technologically confident to model the appropriate instructional application of technology. It appears that the best way to accomplish this is for higher education and school-based personnel to work together to learn and invent new ways to teach with and about technology.

Whereas, inservice or staff development is an established practice in the P–12 environment, the presence of a quality staff development plan is virtually nonexistent in higher education. Higher education faculty need to rethink the meaning of education as they struggle with the infusion of technology. Learning through the medium of technology doesn't mean just delivering the same product over larger distances or with different equipment. It means rethinking the way students acquire information and learn. Faculty must become co-learners with students and preservice and inservice teachers as they explore, navigate, and interpret the information highway.

Needs Assessment

Technology skills needed by teachers were developed with the help of metro Atlanta teachers and administrator. From this list, a questionnaire was created that could be used to assess a person's knowledge and use of technology. This instrument was then used to establish baseline information about GSU faculty, preservice teacher and three public school faculties. The results showed that the vast majority of those responding rated themselves as beginners in the area of multimedia. They also provided evidence that the needs of the preservice, inservice, and higher education teachers are similar and that professional development and learning opportunities in the area of multimedia would benefit all three populations.

Goals and Objectives

Goal I:

To develop Georgia State University faculty who are able to participate in co-reform efforts in technology with selected schools.

Objectives:

1. To prepare faculty to infuse the technology skills identified as necessary for educators into their college teaching so it is a model for P–12 instruction
2. To ensure that GSU faculty are aware of the technology advances occurring in the schools in Georgia
3. To prepare faculty to communicate through and to teach distance learning classes
4. To increase faculty Internet use in the are of communication with preservice and inservice teachers
5. To strengthen faculty awareness about the future of technology as an educational tool

Goal II:

To collaborate more effectively with the public schools' P–12 environment and other university system personnel both at GSU and around the state about the use of technology.

Objectives:

1. To establish a co-reform initiative in the area of instructional technology between GSU faculty and selected middle school and high school teachers
2. To establish appropriate demonstration sites for preservice, inservice and higher education faculty to learn to use technology with existing and new curriculum

Procedures

The first phase of this co-reform began in the summer of 1995 as a result of the faculty needs assessment. This phase consisted of preservice students, school-based faculty, and GSU faculty learning from one another how to more appropriately use current technology. Three metro schools were identified to participate: Berkmar High School, Druid Hills High School, and Taylor Road Middle School. A team of eight teachers from each school agreed to work with a team of eight GSU faculty to create and utilize multimedia for classroom instruction. In order to accomplish this, on going professional development opportunities which mixed these population were established. Classes were taught several times each day by GSU faculty and staff and school-based teachers. These classes were available for (1) GSU faculty in preparing graduate and undergraduate students, (2) GSU faculty wishing to learn more about each topic, and (3) members of the school teams. All members of the school and university teams agreed to participate in not only the summer sessions but a special session on producing a CD in August. Team members also agreed to infuse technology into their lessons during the coming year.

The second phase is occurring during this academic year as the GSU faculty work in the three schools with the faculties and with preservice teachers. Preservice courses now reflect the infusion of technology that was learned during the summer. School-based teachers serve as visiting presenters for on-campus classes. Preservice teachers have opportunities to visit the schools for observations and field experience. Portable equipment has been bought to support the needs of preservice teachers as they infuse technology into lessons taught to school children.

Results

A community of learners from GSU and from the three schools who are able to model the appropriate technology applications when instructing students has been established. Team members revisited their syllabi and infused technology into their lessons. Assignments for the preservice teachers include the use of technology. Middle school, high school and college students are being asked to report information in hypertext and to research using Internet and CD-ROM databases.

Final results from the summer workshops show that the teachers self reported an increased comfort level with the use of technology and there is a statistically significant increase in their skill level. In summary, the results of these analyses indicate that up to this point Project TREEs is accomplishing its goal. Additional data collection and further analyses of quantitative and qualitative data are underway. Data on the infusion of technology is being collected for phase two.

Project

Technology If the Elementary School: A Cookbook of Ideas

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Key Words: **elementary, classroom, integration**

Integrating ever-changing technology into the elementary classroom along with all the other required curricula is a challenge. Many of us did not receive any technology training during our formal education. Therefore we come from a variety of levels, sometimes based on personal experiences. Who should be teaching the teachers? What works best? How do we develop teachers who have a philosophy of the power of technology, not just users of certain programs? Just as we respect individual learning styles when working with children, we must also do so when helping teachers integrate technology into their curriculums. There is no one perfect "recipe," there are whole "Cookbooks of Ideas." Come share one school's experiences in their efforts to create "Master Chefs" from beginning "cooks" and even "non cooks."

Project

Integrating the Internet and Hypermedia in a Workshop for Language Arts Teachers

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Key Words: **professional development, teacher education, Internet, hypermedia**

The Advanced Writing Project

This project session will focus on the methods by which the Internet and hypermedia were integrated during a workshop for language arts teachers as part of the Advanced Writing Project. The Writing Project is a nation-wide endeavor which has included over 500,000 teachers over the past fifteen years. The purpose of the Advanced Writing Project is to have teachers rethink how they teach writing. The computer component, which will be presented in this project session, was only a single component of the sessions comprising The Advanced Writing Project. This project session will describe the approach taken by the instructors during the computer portion of the project. The approach used by the instructors may provide insights into teacher educators' development of their customized approaches to similar hands-on workshops.

The Week-Long Computer Workshop

The original workshop took place over a one-week period during last summer and was followed up with a half-day session in the fall. The purpose of the week-long workshop was to expose the teachers to a variety of Internet- and hypermedia-related concepts and to exhibit how the Internet and hypermedia could be integrated in teaching the language arts. The intent of the half-day, follow-up workshop was to review the concepts presented during the summer. During the workshops, the teachers engaged in hands-on activities in an Ethernet-connected IBM lab.

During the original workshop, an overview of the Internet and hypermedia was initially provided. Throughout the week, the teachers used e-mail to communicate with other teachers and the instructors, subscribed to a number of different listservs, and had access to a variety of newsgroups. The teachers were also introduced to a number of different access methods to "surf" the Internet including *Gopher, Mosaic,* and *Netscape.* A short demonstration was conducted on how information could also be accessed from an information provider such as America Online.

In addition, the teachers were introduced to the concepts of hypermedia development using *LinkWay.* The teachers created autobiographical folders as an initial exercise. As part of this activity, the teachers brought photographs of family members into the workshop and were able to include scanned images of them in their *LinkWay* folders. As a second *LinkWay* exercise, the teachers downloaded part of Charles Dickens' *A Christmas Carol* from the Internet and included this text in their folders. In addition, the instructors demonstrated how pictures corresponding to the Dickens' text could be downloaded from the Internet and included in the teachers' *LinkWay* folders. Finally, writing packages such as *Writer's Helper, SEEN,* and *Children's Writing and Publishing* were demonstrated to the teachers.

The Follow-Up Computer Workshop

During the follow-up workshop, the concepts introduced during the original workshop were reviewed and the teachers' progress was assessed. Almost all of the participants were computer technology novices and were not currently using computer technology in their teaching when they entered the summer workshop. A questionnaire was distributed during the follow-up workshop that helped us gather information concerning the ways in which the teachers implemented Internet- and hypermedia-features in the time period ranging from the initial workshop to the follow-up workshop and general attitudes toward the workshops.

Feedback from Participants

Feedback from a question asking how they may have been able to implement certain features from the original workshop indicated that the teachers had used the technology tools for demonstrations to their students, for student teaching training, and for accessing materials to integrate into their teaching. Another teacher indicated that she had influenced the administrators in her county to purchase hardware and software for Internet connectivity.

In response to a question asking for an explanation of why they may not have been able to implement certain features from the original workshop, almost all of the teachers' comments centered on a lack of time, access, and training. One teacher commented, "Just wish we could have access to basic hardware/software, etc. in local schools–also need to train local teachers."

Feedback to a question asking for suggestions on improving the workshop, the majority of teachers' comments again dealt with the issue of having more time and being provided more training.

Conclusion

The feedback provided by the teachers indicated that they had found practical ways of using the knowledge and skills that they acquired during the initial workshop. However, there was a discrepancy between what they had learned during the workshop and what they were able to accomplish when they returned to their classrooms. The main reasons reported by the teachers for this discrepancy were: a lack of access to hardware, software and telecommunications; a need for time to explore; and a need for more in-depth training.

Paper

Comparison of Young Children's and Preservice Students' Performances in Using the StoryBook Weaver Program

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Key Words: StoryBook Weaver, young, children, preservice

Abstract

Young children are naturally drawn to stories. Computerized storybook maker programs can provide a means to motivate young children to learn to read and write as they play. To compare the differences between how young children and adult students perceive and perform using the *StoryBook Weaver* program, 26 first graders and 23 preservice students participate in the study. The results of the study present significant differences.

Introduction

Young children enjoy learning in the story environment. They enjoy listening to stories and making up their own. Today's computer programs may facilitate an exciting learning environment to motivate young students to learning throughout story activities. Kinscher (1995) points out that interactive storybook software has many advantages and it especially allows students to internalize the story. Today's computer storybook maker programs can provide an even better means to serve the enlightening purposes. The researchers find that the storybook maker programs, as a step further beyond the interactive storybook programs, can encourage children to attempt more in reading and writing activities, and become more strongly motivated because these programs can promote not only the receptive skills but also productive skills. Thus such rationale posits a need to infuse the storybook making technology into the elementary curriculum and to involve preservice students in using the storybook maker programs to develop potential instructional materials.

The storybook maker programs are the software programs that provide users the tools to compose on a computer with graphics, text, sound, and speech capabilities. For example, *My Own Story* (1994) and *StoryBook Weaver* (1992) by MECC, are two of the most popular storybook maker programs. According to the manuals of most of the storybook maker programs, these programs intend for users to bring imagination to stories with graphics and text. They also encourage teachers to develop stories and share them with the students as role models. This sounds very exciting at first, however, when we tried to develop instructional story materials for young children with the program, we learned of a big gap between ideal situation and reality. To further investigate how these programs can be integrated into the curriculum, this study intends to explore the following questions:

- How do young children differ from adult students in using the storybook maker program in terms of working approaches or styles, appreciation of the program, creativity, and quality of the products?
- Are the storybook maker programs suitable to serve as a tool for teachers to develop good instructional materials to teach young children?
- Under what circumstances can the storybook maker programs be used to teach young children effectively?

Subjects and Grouping

The subjects of the study, as shown in Table 1, are 26 elementary first-grade students (ages 6 and 7) in Lincoln Elementary School at Whitewater, WI, and 23 college preservice students majoring in elementary education at the University of Wisconsin-Whitewater. Both the children and the adult students were not familiar with the *StoryBook Weaver* program prior to the study. The adult students have a little experience in using computers for word processing and graphics tasks on IBM computers while only a few children had slight exposure to computer games. Both groups of students were alerted that they would be composing stories on a Macintosh computer with a storybook maker program one week in advance.

To investigate the impact of grouping on composing with the storybook maker programs, both children and adult groups were randomly assigned into individual groups and pair groups.

Table 1: The percentage of the children and the college students

	N	%	IBM experience	Mac experience	Storybook experience
First graders	26	.53	5	3	0
College students	23	.47	23	4	0

Design of the Study

To investigate how the *StoryBook Weaver* programs were used, the researchers carefully examined the differences of the performance and the outcome between all groups of students by observing how students proceed to complete the tasks; how frequently students applied the story making elements in the program time they devoted to composing; and the quality of their final products. In addition, information about their attitudes toward the program were collected. Before and after students' exploration of the program, they were surveyed for their perceptions about the usefulness of the storybook maker programs. When they finished their stories, they were also asked to rate their satisfaction with the program on a one through five scale.

Both adults and the children were introduced how to use the Macintosh computer, the *StoryBook Weaver* program, and the *SmartVoice* speech program (1994) for about fifteen minutes. They were then encouraged to try out the program on their own and compose stories on the computers. The researchers maintained a reflexive journal based on the persistent observations.

Results of the Study

Both adults' and children's performances of composing stories on a computer are described as follows.

Adult Group's Performance

After the adult students were shown how to use the program on a Macintosh, instead of trying out the features on the computers, most of them started by thinking and engaging an extensive conversation talking about possible story topics. Soon after they began to compose, they became frustrated since they were forced to re-adjust their story ideas due to the limited choice of graphics for the scenery, sounds, and objects. They tried the computer speech and were not too amazed at the quality. They tested the sound association with the objects and decided not to use too much in their stories. They completed their stories at random and quit soon. Most of them finished within an hour.

Children Group's Performance

The young children group showed a stronger degree of excitement. Nearly all of them started their journey by exploring the scenery selections and object graphics. Very soon they became occupied by the graphics features of the programs such as moving, resizing, rotating, and inverse. They showed strong enthusiasm and kept on trying to find the possible matches for their imagination. They loaded many character objects and figured out how to modify the object. They played with the sound association and applied different sounds to all the objects on the computer screen. Although the computer speech was of lesser quality, they turned the speech function on and enjoyed listening to the computer speech. They were curious about how computer synthetic speech was generated. After they were finished with their own stories, they loaded other example stories and played with the stories. They also exchanged stories to show off what they had accomplished. After nearly two straight hours, they did not show any sign of fatigue, and some of them asked for even more time.

Young children's performance obviously differs from that of the adults in their approach, appreciation, and creativity. Most young children's works reveal their creativity and their eagerness to explore and to express themselves. Regardless of the contents, their stories are exciting. However, most of the original stories developed by adult students are of poor quality and cannot be used as effective instructional materials to enhance young student's reading ability. Some of their stories are awkward to read because of mixed styles of text (such as all-italic, all-caps), misspelling, tiny print, poor selection graphics, poor screen design, and inappropriate choice of words for the scripts. The detailed comparison between children and adults' performances are discussed below.

Analysis of the Differences Between Adults and Young Children

Motivation

A great many of adult students act hastily as if they were pressed for time to complete the assigned task as a duty to fulfill the course requirements. All the young children, on the contrary, seem to explore the program for fun. According to Brown (1980), there are two different kinds of motivation: instrumental and integrative motivation. The way that adult students rushed to finish their task may be characterized as having instrumental motivation while the children's performance may be characterized as having integrative motivation—they learn with eagerness and enjoyment. Learners with the integrative motivation tend to perform better and achieve more.

Approaches

Adult students in this study seemed to organize their stories following a rigid strategy. They started with some ideas for the story before they proceeded. They intended to compose stories based on the given ideas and story structure in their minds. However, they soon became frustrated because of the limited choices of sound, scenery, and graphics. Young children, on the contrary, started with exploration of the features and elements in the programs such as scenery, graphics, sound, and graphics manipulations. They quickly tried out the combinations of the scenery, sounds, and object graphics and organized the best combinations before they began to worry about the text content of the stories. Young children seemed flexible, and maintained high levels of curiosity and enthusiasm when they tried out the *StoryBook Weaver* program.

Time Spent

Adults spent an average of about 40 minutes exploring the program and creating their stories. Young children spent an average of 120 minutes continuously working on the computer. Some young children even begged for more computer time during recess.

Elements Used and Features Tried

Since the *StoryBook Weaver* program provides many elements and features, the exploration of these items is crucial to reflect student's approach to completing the tasks. Most young children did not compose their stories with too many pages. Instead, they spent most of the time exploring possible combinations of the sound, speech, and graphics elements, etc. The adult students did not seem as interested in thoroughly exploring these elements and features as the children did.

Table 2: The average number of elements/features used in the story

Features/Elements	First graders (N:26)	College students (N:23)
scenes/pages	2.5	5.5
objects/characters	15	8
object resizing	10	3
object rotation	11	2
sound associations	12.5	5
frequency of using the speech	5.5	1

Most Enjoyed Features of the Program

Adults and children have different values about the program. Adults seem more concerned about the overall design of the program while children pay more attention to the detailed functions the program can provide. Adult students reported to have enjoyed the ease of use of the program and What-you-see-is-what-you-get (WYSIWYG) features the most. Young children reported to have enjoyed the graphics and speech functions the most.

Quality of the Finished Story Products

Based on the first grade teachers' experiences of young children's literacy skill, the researchers established some criteria and examined the finished stories and scored them on a one through five scale. The criteria and the rating for both children and adult students' stories are shown in Table 3. Young children's stories are more exciting than the adult students' works. Although most of the stories, by either adults or children, seemed not suitable to meet instructional purposes, we were astonished to learn that these adult students seriously lack the knowledge of using appropriate vocabulary or language for young children. Young children had limited vocabulary and needed help with some wording and spelling, however, they can still construct exciting stories.

Table 3: The mean score of the quality criteria in the stories based on a five-point scale

Number of elements	First graders (N:26)	College students (N:23)
Interesting plots	4.5	3.0
Meaningful content	3.5	4.0
Meaningful sequence	4.5	4.8
Screen design and paging	4.5	4.0
Appropriate vocabulary	4.5	3.5
Matching graphics/sounds with content	4.8	3.8
Serve instructional purpose	3.0	3.5
Average	4.2	3.8

Special Needs

The program is self-explanatory and easy to use. The fact that all young children were able to run the program without problem proves that further instruction or program help is not necessary. However, young children do not have good literacy skills and still need the adult's help with their spelling and typing.

Table 4: Distribution of students' self-assessed mean attitudes toward the program

Self-stated attitudes	First graders (N:26)	College students (N:23)
"Believe young students can benefit from the program"		
Before	4.5	4.0
After	4.8	3.8
"Enjoy the program"		
After	4.9	4.0

Self-Stated Attitudes

As shown in Table 4, young students seemed to have enjoyed the program more than adult students and held stronger positive attitude toward the program after they used the *StoryBook Weaver* program.

Team Group Versus Individual Group

Generally speaking, students working in teams performed better and enjoyed more than those who were not. The differences between the elements tried, quality of the story, and appreciation of the programs are shown in Table 5.

Table 5: Distribution of scores between individual groups and team groups

Items:	Y-T (N:18)	Y-I (N:8)	A-T (N:16)	A-I (N:7)
Elements/Features:				
scenes/pages	2.8	1.8	6	4
objects/characters	18	8	10	3.5
object resizing	12	6	4	1
object rotation	12	9	2.5	1
sound associations	13	11	5.5	3.8
frequency of using the speech	6.5	3	1	1
Quality of the Stories				
Interesting plots	4.6	4.3	3.0	3.0
Meaningful content	4	2.6	4.0	4.0
Meaningful sequence	4.5	4.5	4.8	4.8
Screen design and paging	4.6	4.3	4.0	4.0

Appropriate vocabulary	4.5	4.5	3.7	3.1
Matching graphics with content	4.8	4.8	3.9	3.6
Serve instructional purpose	3.2	2.6	3.7	3.1
Attitudes:				
"Believe young students can benefit from the program"				
Before	4.6	4.2	3.9	4.2
After	4.9	4.6	3.9	3.6
"Enjoy the program"				
After	4.9	4.9	4.1	3.8
**Y-T: Young team group Y-I: Young individual group A-T: Adult team group A-I: Adult individual group				

Implementations and Recommendations

From the findings of this study, we realized that young children don't need good computer skills or literacy skills before they can compose on a computer. We also learned that simply putting ideas and materials onto the computer does not necessarily make a good story. The storybook maker programs seem to meet the needs for young children. Young children undoubtedly enjoyed the storybook maker programs more than adult students. They showed greater appreciation and spent long hours playing with the program. Most adult students were frustrated by the programs while young children were actively exploring the programs with enthusiasm. Young children may actually benefit more from using the program to improve their computer and literacy skills since they have strong integrative motivation and they view the storybook maker programs as both a tool and a toy. As shown from the results, cooperation and collaboration among students proved to be a successful strategy in engaging students to use the storybook maker programs. We should encourage young children to learn to share their ideas and to express themselves through the programs.

One major difference lying in their approaches to composing between adults and children is that young children tend to construct their stories by organizing graphics first to construct the content of the stories, while the adults tend to organize the ideas or the contents of the stories before they work on the picture objects.

An interpretation about the performance differences between children and college students may be related to the fact that college students hold different attitudes toward technology. On September 20, 1995, David Frazier commented to the ED-TECH listserv discussion, "I have had more experience with college students and have found most to be anti-technology. They have to be forced to use computers at all. This is contrary to the high school students I have worked with, who usually seem much more eager to dive in to new technology." The finding of the differences between adults and children in this study also matches the Barba and Mason's research finding (1994) where they stated that young children view technology differently than adults in that they view technology as part of everyday life, as part of many careers while adults view science and technology as being an undifferentiated meld.

Creating meaningful stories with the storybook maker programs is more difficult than what the manuals of these programs suggested. Many adult students did not feel comfortable composing on the computer, especially with the *StoryBook Weaver* program. We come to know that developing a meaningful story requires true understanding of the story structure, good ideas, efficient problem-solving strategies, sufficient choices of graphics and sounds, meaningful scripts for the stories, and good strategies to tell the stories (e.g., making good use of graphics and sound for the story presentation, and relating story contents to young children's prior knowledge). It also takes patience to compose a good story. We should define the necessary elements such as scenery, colors, graphics, sounds, video clips, text, and speech features which may be essential to successful development of stories by adults. We can then examine if these crucial elements are missing from the current programs for successful composing of meaningful stories. Finally, we should also form story-composing strategies that adults can employ to produce good stories using these programs, and establish certain criteria to differentiate good stories from bad ones.

Preservice students differ from young children in appreciating the *StoryBook Weaver* program. Young children maintain a high degree of curiosity about the mechanical process of the program as well as the best approach to choose pictures to construct more meaning settings for the stories in their minds. However, unfortunately, the adult students, neglecting the true value of using the program for better story telling and communication, concentrate very much on the mechanical process of retrieving and manipulating images in the program to complete their missions in the assignment. The storybook maker programs have provided a great potential to help young children turn imagination into stories, communicate in a more significant way, and become strongly motivated to learn to read and write better. Preservice students should be more frequently exposed to the computer-enhanced learning environments, and be systematically introduced to appreciate the value of good learning materials and to learn effective uses of the existing computer technology for instruction. Other similar application activities should be integrated in the current teacher education programs to help the preservice students establish proactive attitudes and performances.

Future studies investigating the relationship between the storybook maker programs and young children's thinking patterns and learning styles are highly desirable. In order to generalize the findings of this study, similar studies should be performed with larger samples of children and adults. Other studies are also desirable, such as the comparison of effects between different storybook maker programs, as well as comparison between the electronic and the printed versions of stories, or the colored and non-colored version of stories for children.

References

Barba, R. H., & Mason, C. L. (1994). The emergence of the "nerd": An assessment of children's attitudes toward computer technologies. *Journal of Research on Computing in Education. 26*(3). 382–390.

Brown, D. (1980). *Principles of language learning and teaching.* Englewood Cliffs, NJ: Prentice-Hall, Inc.

Kinscher, S. (1995). What are interactive storybooks? *WSRA Journal 39*(1). p.44.

My Own Story [Computer software]. (1994). Minneapolis, MN: MECC.

SmartVoice [Computer software]. (1994). St. Clair Shores, MI: Quality Computers.

StoryBook Weaver [Computer software]. (1992). Minneapolis, MN: MECC.

Focus

Integrating Internet into the Teacher Education Curriculum

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Key Words: **teacher education, Internet, educational technology, preservice teachers, World Wide Web, technology**

The Internet and Teacher Educators

Technology has failed to make a significant impact on teacher educators. The integration of the computer into the teacher education curriculum is a typical example. Although many teacher education programs have some form of computer training for students, it is not unusual to find teacher educators who lack the expertise to use computers or integrate computer technology into their courses. The recent growth of the Internet, like the advent of the computer technologies, may or may not be an asset to the teacher education curriculum. However, the Internet is different than other electronic mediums for several reasons, primarily that:

1. Internet provides instant, up-to-date information at the click of a mouse button. Current information can be accessed in the form of text, graphics, photo images, video, and sound.
2. Internet caters to individual needs. Users can navigate in any direction on the World Wide Web at their own pace. Unlike computer technologies which have some of these capabilities, Internet enables individuals to spontaneously interact and share information with the world. Teacher educators need to be aware of these capabilities and the implications for future teachers.

Internet Across the Teacher Education Curriculum

University administrators and faculty members should assume the leadership in helping faculty members and students use Internet. Faculty members should have access to Internet through their classrooms and offices. It would also be beneficial for faculty members to have access to Internet from home. A campus system should be established in which faculty members have access to Internet support. Many universities have computer centers that provide this type of assistance.

Faculty members should be encouraged to attend workshops and to establish home pages. Universities should provide inservice training to faculty on campus. Education professors should assign Internet-based activities during field experiences, give course assignments requiring use of Internet, incorporate Internet training into coursework, encourage students to join professional usergroups, and encourage students to establish home pages.

Internet Resources for Teacher Educators

Internet is a dynamic medium where information changes on a continual basis. New web sites appear daily while other sites may change location. Teacher educators should explore the Internet to find web sites that meet their particular interests and needs. Following are some areas in which teacher educators may begin to find resources:

1. Search Tools: Search tools such as *Net Search* or *WebCrawler* can link teachers to web sites by typing in key words.
2. Publications & Journals: Many publications and journals have web sites. Articles may be electronically published in their entirety or found in abstract form.
3. Government: Numerous government web pages are found at the state and national levels.
4. Colleges & Universities: Colleges and universities have web sites that link users to various campus resources including the campus library.
5. Professional Organizations: Professional organizations maintain sites that give information pertaining to organization activity, conferences, and journals.
6. Newsgroups: Newsgroups can be found which are custom designed for teacher educators.
7. Miscellaneous Sites: Many sites contain myriad information on general topics of interest for educators. Some examples are Yahoo, Eric, Edupage, EdLinks, Education Resources, Internet Resources for Teacher Educators, and the Teacher Education Internet Server.

Issues

Internet is not without its share of problems and criticisms. Faculty members need to be aware of the following issues and discuss them with colleagues:

- Internet takes time to download information
- Internet can be costly in terms of equipment and facilities
- Internet can be difficult and expensive to access and use
- Users are sometimes not able to get the information needed
- Many web pages have been poorly designed
- Students have easy access to pornography and "bad" language
- Internet is commercialized

Intranet

Schools of education should consider the structure of an "intranet"—a private web site that some companies are using to transform their organizations. The "intranet" structure would network professors within the education department and give them complete access to the World Wide Web. Unauthorized users could be prevented from reaching specific sections of the University network. Such a system could be effective and efficient in terms of money and time because it allows for the transfer of information by combining all the hardware, software, and databases of the department into a single system.

Summary

Internet has information for everyone. Professors of education, as leaders of teachers, need to know how to use Internet for resources and how to integrate their classroom with the World Wide Web. Internet has the potential to help future teachers become future leaders of change in our schools.

Project

Web Publishing Motivates Third Graders to Learn and Improve Skills

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Key Words: **elementary education, integrated curriculum, language arts, science education, social studies, special populations, Internet**

Third grade students at Cottage Grove School have been working together in teams of two or three students in order to research topics and design and write reports for publication on the Internet. These students became much more interested in improving their reporting and writing skills when they realized that their reports could be read all over the world as well as by their parents and others in their community. They are excited at seeing their social studies reports Web-published and are now enthusiastic about researching and writing their science project reports. Parents have been eager to see their children's projects and have taken more interest in school activities.

The concept for this project was developed shortly before the start of the 1995–96 school year after a local educational software and Internet-based educational materials publisher offered to provide free technical assistance and disk space on their EarthLab server for the Internet publishing of student authors. We decided that this was worth trying and worked together to design a program to begin with the fall semester. Called the ELSA (EarthLab Student Authors) project, it has been very rewarding for all participants, and we are now expanding it to other classes within our school and planning to help other schools join us.

Our current building theme of "Hand in Hand—Together We Learn" was chosen as the theme for the school's home page, suggesting not only how students and teachers were learning together about how to explore the Internet, but also in how the Internet can be used to facilitate "hand-in-hand" cooperative learning, even though over great distances. My third graders and I held numerous discussions on what kinds of information people might want to see on our home page. They then gladly accepted the challenge of creating the first set of reports from our school on the subject of our school and our community. It fit into our first social studies unit of the school year which is about our local community, Cottage Grove. Students brainstormed about the different aspects of the community and school they could report on, then picked the topic they wanted to research.

We explored different sources of information we could use. The list was extensive, including phone books, surveys, maps, interviews (in person and via telephone or paper), newspapers, and books. Students developed a Plan of Action, writing questions to answer or listing sources to use. Composition took place right on the computer. The students seemed much more willing to edit and revise their writing when done on the computer. We used Scholastic's *Student Writing Project*. This program, along with *Kid Pix*, was used to make the graphics which was inserted into the text. The Instructional Materials Center/Learning Technology coordinator contributed her computing expertise and knowledge of these two programs. Students also used the scanner for such things as maps or other pertinent information, and we used the digital camera to take photos of each student and groups of students in action.

These students were a typical third grade class, not an accelerated group of students. While there was a wide range of abilities, the greatest population was IAP (Individual Achievement Program—our school district's version of Chapter One) students. They lacked many skills expected from beginning third graders. But their sense of ownership in this project encouraged them to develop a more mature approach and produce more developed and more creative work.

This project presentation will display examples of the students' Web pages and summarize our experiences into principles for using Web publishing to effectively motivate students to take charge of their own learning at an early age. We will also present guidelines for effective collaborations between computing professionals and educators. And we will provide information about the opportunity for other schools to join the ELSA project and use Web-based publishing to encourage learning through student authorship.

Project
Schools of Tomorrow...Today!

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Key Words: **HyperStudio, outcome-based curriculum, integration, magnet technology school**

L'Ouverture Computer Technology Magnet, a K–5 inner-city public school, demonstrates outstanding use of technology in education and has been recognized by *Redbook* Magazine as "One of the Best Schools in America." We use computers distributed throughout the building. Each classroom has between seven and 11 Macintosh LCII computers, all interconnected to four servers. In addition, each classroom is equipped with a 27" monitor used for both computer demonstrations and closed-circuit television. Every student in grades 1–5 learns how to use *HyperStudio* to create interactive programs. Students explore the world using the Internet. Many software programs are used, including the *SuccessMaker* individualized learning software. In addition, students produce a live television broadcast each day.

In our presentation, we will discuss and show various applications of software and hardware that are used to enhance rather than drive our outcomes-based curriculum The focus will be on how to integrate technology into the classroom to enhance learning. Student-produced applications and projects will be shown and plans for the future discussed.

Project
Making Accessible for the Deaf CD-ROM Reading Software

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Key Words: **accessible, deaf, sign language, CD-ROM, reading**

For hearing students, CD-ROM technology with its large text storage, colorful graphics, animation, and digital voice/sound capabilities, is a rich tool for reading instruction. The learner has the opportunity to interact with a visually and auditorially stimulating screen as he or she directs an exciting and enjoyable reading experience.

Deaf students do not hear the auditory message and it is impossible to speechread animations. Deaf students' reading ability is typically too low to understand any printed captions. In short, without modifications, deaf learners are not able to learn and enjoy the engaging CD-ROM reading software currently on the market.

The reading book, *Rosie's Walk*, published by Macmillan, was transformed into a CD-ROM, and both American Sign Language (ASL) and Signed English *QuickTime* movies were added so that deaf learners can enjoy and appreciate the story. There are approximate 10 to 15 animations on each page of the story. Animation features provide additional entertainment to the story as well as a way to present additional meaningful vocabulary of close to 100 words. The user can either select from the "Secret Words" list or just explore by clicking on a graphic to see the sign for that picture, see and hear the word for that picture, and then enjoy seeing an animation involving that picture.

At the end of the story there are several games that help reinforce the concepts and vocabulary taught in the program. For example, the game "Sign Language Review" provides a place where all the text in the story can be reviewed in ASL or Sign English, or individual words can be reviewed. The "Signs to Pictures" games require the user to read the sign language and then select the picture that represents that sign. Nouns and preposition are emphasized in separate games. The "Signs to Words" game randomly selects and presents a sign and the student selects the appropriate word that matches the sign. The "Match Word with Picture" game shows the word, and then students match the appropriate picture. In the last game, "ASL to English," students watch a short presentation of ASL, then drag the scrambled words and place them in the appropriate English word order.

Uniqueness

Rosie's Walk is the first children's story made accessible for the deaf. It includes American Sign Language (ASL) and Signed English to enable deaf children to understand and appreciate the story. The *QuickTime* movies are presented in a 320 by 240 (pixel) image size so they are easily seen. There are over 120 *QuickTime* sign language movies presented. An accompanying teachers guide provides an extensive variety of activities that focus on specific learning objectives and use Whole Language principles.

Benefits for Hearing Students

Rosie's Walk includes all the sound you would expect from a CD-ROM developed for hearing children. In addition, hearing students enjoy learning sign language from this program. The short phrases, individually signed word vocabulary, and frequent repetitions provide an excellent tool for hearing students to learn sign language. Every elementary library in the country would enjoy and benefit from this CD-ROM.

The school version of *Rosie's Walk* includes 5 teacher/students activity manuals and lists for $79. The consumer version is $49.95. Educational Resources at 1-800-624-2926 and Gallaudet University Bookstore (800-451-1073) carry this CD-ROM. *Rosie's Walk* will run on a 68040 or better Macintosh and 486-66MHz PC computers with the soundblaster chip. You may purchase *Rosie's Walk* directly from the Texas School for the Deaf if payment is made via personal check or money order. Our price is $59.95 for the school version and $34.95 for the consumer version. To purchase, please send your check or money order to the Texas School for the Deaf, Att. Cashier, PO Box 3538, Austin, TX 78764 and indicate if the school or consumer version is wanted. There is a $6 shipping and handling fee with each order. Texas residents must add 8% sales tax.

Panel

Are They the Same or Aren't They? The Adaption of the Closed Laboratory Model for CS1

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Key Words: CS1, closed laboratory, course development, course adoption

In 1992, the University of Virginia began a complete revision of its undergraduate computer science curriculum. One of the cornerstones of the new curriculum is the use of closed laboratories in the first four core courses. In the closed laboratory, students gain experience with many real-world practices. They are exposed to real-world practices where programs are thousands or millions of lines long, are often extensively modified and maintained rather than merely constructed, are manipulated in a tool-rich environment, where work is almost always a team effort, and where the form of a solution has a profound impact on future cost and performance. Students have the opportunity to experiment with different ideas and approaches without grade penalty. They are encouraged to share their ideas and solutions with not only the instructor but with other students. They can experience disasters without the consequences of a "real" one.

The flexibility of the closed laboratory model is demonstrated by the adaption of the UVA closed laboratory materials by Northwest Missouri State University and the University of North Texas. UVA, Northwest and UNT are very different institutions yet each has a closed laboratory component to its first computer science course. The philosophy underlying the approach at Northwest and at UNT is essentially the same as that at UVA. However, Northwest is primarily an undergraduate institution with small class size, enabling a different approach than that of UVA.

The primary goal of the project at Northwest is to use closed laboratories to develop active learning environments, in the process promoting teamwork and development of lifelong learning skills. This is being done through the daily integration of lecture and laboratory sessions. At UNT, the format is that of a traditional university where both the undergraduate and graduate experiences are available. While lecture sections are taught by regular faculty, graduate student fellows provide the major assistance for the undergraduate laboratory sessions.

The move toward closed laboratories was prompted by the realization that students lacked fundamental programming skills that could only be acquired through an active learning environment. While the move was accepted by most faculty and student, it did not come without pain, particularly for those faculty who had to accept a new model of teaching programming.

The panel discussion will focus on the flexibility of the closed laboratory model, the department decision to incorporate the closed laboratory model into its curriculum, the process and experience of adapting existing materials to one's unique environment and the evaluation of the effort. An example of the "same" closed laboratory will be presented by each school.

Project
Using Netscape Navigator to Teach High School Research Skills

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Key Words: **Netscape Navigator, high school, Internet**

Before the introduction of the Internet into the classroom, students doing research at Lakeville High School used online and CD-ROM technologies that accessed large databases to provide numerous resources for their research. With Internet access and the development of a user-friendly web browser called the *Netscape Navigator*, students have unlimited resources for research.

This project session demonstrated practical techniques of using the World Wide Web to teach high school research skills and displayed typical student searches using *Netscape Navigator*. During the demonstration, participants viewed search engines used in narrowing a research hypothesis. During discussion, the presenter examined strategies for narrowing a research hypothesis and evaluating the credibility and reliability of an online source.

This project session identified effective search engines to guide in research topic selection, listed methods to limit research sources, and identified elements that might indicate bias and credibility of source documents.

Project
Merging Hypermedia and the Internet: A Hamlet Project

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Key Words: **hypermedia, Internet, language arts**

Project Overview

The purpose of this project has been to integrate a language arts resource found on the Internet into a hypermedia-based learning shell. This instructional approach is in the constructivist vein of student learning, where students use the resource as the contents of a hypermedia program they are developing. Specifically, the electronic form of *Hamlet*, available from the electronic library at the University of Minnesota can be downloaded and then "fed" into a *HyperCard* shell. Students then, while working in groups, might decide what words need to be defined and excerpts which need interpreting. Essentially, students work in groups (collaborative learning), define words (vocabulary development), and interpret parts of the play (researching and critical-thinking skills).

Limited Resources

This project has been developed with the one-modem, five-computer classroom in mind. By placing students in groups, the use of the usual limited resources is maximized. For example, each of the five groups can use the modem one day a week to access and download related Internet-based resources, contact *Hamlet* experts via e-mail, and/or contact other students also studying *Hamlet*. This approach also gives each group a computer. Because not every student will have a computer—rather, each group will have one—students should begin to view computers as a development work station and should spend more time planning, researching, and collaborating.

Collaborative Learning

Like all of Shakespeare's plays, *Hamlet* is in five acts. For this project, each student-group would be assigned one act to turn into a hypermedia program. Collectively the class of students turns the entire play into a hypermedia program. Students, in addition to knowing the act assigned to their group quite well, can then use the entire hypermedia program to learn the play. The instructional goal of this project is for the students to develop a hypermedia program for others to use for learning *Hamlet*.

Students can also be taught to scan pictures—pictures of *Hamlet* characters found in Shakespeare books, for example—and incorporate them in the program. In recent versions of *HyperCard* there is an audio program; students can record tapes of actors speaking the lines or can speak their own definitions or interpretations. With additional equipment and software, students could also capture video on the hard drive that can then be visually displayed on the screen.

Other Benefits

There are other benefits of this approach. By downloading electronic versions of the play and other literary works, limited monies can be freed up to purchase non-electronic versions of literary works, especially multicultural works. The reason the standard, traditional, "classical" literary works are available on the Internet and, thus, are free is because their copyright has expired.

By using Internet-based resources, teachers have more flexibility in their curriculum. For example, there may be enough print copies of *Macbeth*, but maybe the teacher prefers to teach *Hamlet* or *Othello* or a history or a comedy. All of these are available in electronic form. As stated before, most of the "classics" are available. Also language arts resources cover the grade-gamut, from elementary to college; *Peter Pan* and *Aesop's Fables* are available as well as the works of W. B. Yeats.

The approach also "tames" Internet use via accessing *Hamlet*-related resources and information as well as e-mail messaging to contact Shakespeare scholars and listserv's or chat groups to discuss with others also interested in *Hamlet*.

Summary

In summary, this approach meshes knowledge acquisition, vocabulary learning, critical thinking, research skills, and technology skills—all of which fit well with the expected skills, knowledge, and experiences students should have.

This presentation will focus on the *Hamlet* hypermedia/Internet program, its development, and instructional implications and guidelines.

Project
Techlearning and Techteaching Pilot Project

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Key Words: **technology, learning, teaching, techlearning, techteaching**

In the Fall Semester 1995, a collaborative project was started between McAllen ISD and the University of Texas—Pan American to use media and technology systems to enhance classroom learning and teaching. This project, the Techlearning and Techteaching Pilot Program, provided field-based graduate courses in media and technology systems for twelve McAllen High School teachers, supervisors, counselors, and administrators during in-school and after-school hours. This program provided the university professor an opportunity to be on-site in the school and to observe the interaction of the high school personnel with each other and with the students during instructional or related situations. The university professor was able to interact and to work with the school personnel individually, in groups, and as an entire class to innovate teaching and learning activities by using a broad spectrum of media and technology systems.

Why Techlearning and Techteaching?

Textbooks and teacher-talk constitute much of the instruction in schools and colleges in the United States today. This type of conventional instruction is no longer relevant or motivating for many students and it's certainly not preparing them for the world of work or to cope with the present and the expanding scientific and technological future in which we are immersed. Educators have a responsibility to use the latest methods and techniques for learning and teaching. Several simple instructional innovations were developed and used in this program to stimulate and to improve communication and learning in schools and colleges:

- Open the classrooms to the information, ideas, and events that surround the schools by using modern mass media and technology systems.
- Maintain an open dialog and discussion in the classrooms where both the students and their teachers are able to present and use information so that they will be able to make better informed judgments about the events of the past, the present, and the future which greatly affect their lives.
- Establish a collaborative environment in the schools where students, teachers, parents, and other community members become active, independent, continual learners whether in the classroom, in the home, or in the community.

The participants in the Techlearning and Techteaching Pilot Program at McAllen High School are able to:

1. develop and apply innovative learning and teaching practices in microteaching and macroteaching sessions in the classroom, in planning groups, in counseling sessions, in meetings, and in supervisory and administrative decisions,
2. be continual learners along with the students, fellow teachers, supervisors, administrators, parents, community, and business members,
3. use media and technology systems to acquire, organize, present, and transfer information, events, and ideas within the classroom and beyond to the students' homes, to the community, and to other sites in the world,
4. involve students in techlearning and techteaching situations which will prepare them for lifetime learning through the application of information, events, and ideas to enhance the quality of life, to benefit human welfare, and to accelerate social progress,
5. help support and procure media and technology systems to provide techlearning and techteaching practices to enhance the academic programs in McAllen Schools.

There is an urgent need to begin to modify the conventional classroom into a multimedia classroom. The development and use of a few classrooms as Centers for Techlearning and Techteaching as suggested by this pilot program will not be a panacea for McAllen High School. However, it will be a start in a new direction and will provide limited numbers of students and their teachers a departure from their dependency on the textbook and teacher talk. This does not imply that the teachers are not doing their jobs and are not successful. This pilot program will provide an open dialog in the classroom and a vast variety of new communication methods and tools that are already available to the general public and commercial establishments. This departure will move the school board, administrators, teachers, students, parents, community, and business organizations in a more positive direction so that the students will be better prepared to meet the challenges they will encounter in our future technological, scientific, and diverse society.

Project
Research Science: Using Technology Now to Build a Better Future

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Key Words: **science research, Blue Ice, water chemistry, environmental, Internet and Web sites**

We are promoting the concept that our world, because of technology, is far different than the world of just a generation ago—that we now more than ever impact each other on a continual basis. "What we do in our own backyard affects people and the environment all over the world, and what happens in other parts of the world affects us." This concept brings up the necessity to involve students from all over the world in interaction and research—we cannot isolate ourselves as this will not solve the problems. We must begin working together, and technology will allow us to communicate and build these relationships.

We also firmly believe in conducting scientific research on real world problems in order to promote and enhance:

1. the team work that must take place among students in their own class and among students of different schools. In real life, projects and ideas are not isolated matters—many different disciplines come into play. Students will realize the importance of team work when they are working on a real research project in which they must collaborate and rely on different people within and outside of their school. It takes many people with a variety of talents to problem-solve effectively.
2. the ownership students have in their own learning. By collaborating on a long term project which is important to them—a problem they can truly relate to—students will be motivated to learn and to do quality research. Students will also have an opportunity to work with professionals and community members, giving them a better sense of their own individual importance as citizens. Students will begin to feel empowered—that they can make a difference in local and world problem solving.

3. the confidence students gain in their abilities to conduct research, work as a team member, communicate effectively, use technology appropriately and efficiently, write and analyze technically, and think critically.
4. a better sense of our responsibilities as stewards of the earth.

We are hoping to create a research community of teachers and students that can serve as mentors and resources for each other and also to build long term relationships with professionals in the field whose expertise we can draw from, in order to increase the quality of the research. We are hoping to create real life projects for these students and to expose them to how real research is carried out. Technology is the tool that allows this type of interaction to be possible.

This presentation will give concrete steps the classroom teacher can use to develop research projects for their students locally, and disseminate their work and ideas with students globally. We will discuss the research projects which we participate in, how we got started, how we are connected with other schools, where we are headed and how we use technology to make it all happen.

Focus

A Little or a Lot: Teacher Technology Training that Hits the Spot!

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Key Words: **training, inservice, elementary, classroom, education**

Teacher training is an important part to a successful technology plan and the success or failure of technology use in a school. Many times, this integral piece is overlooked or added on at the last minute. This session will explore workable ideas and solutions used in elementary schools to introduce teachers to technology in non-threatening, supportive ways.

The session will focus on determining the level of expertise of each teacher, attitudes toward technology, ways to get beginners started, intermediate and advanced users to the next level, mentoring partnerships and projects that can be used to encourage technology use in education, and higher education-preservice teachers/elementary partnerships. In addition, ways to get the word out about what teachers are doing and the great ideas and strategies they are using will be shared. Classroom setups, creative time slots in scheduling, lab vs. classroom computer use, and individual and cooperative learning will also be examined.

Whether your school has "a little" or "a lot" of technology, resources, and time, you will be introduced to innovative ways of getting your teachers involved in technology and how they can apply it to their classroom and professional life.

Focus

Terrific Teaching Tidbits from Technology Toting Teachers for Technology Tenderfoots

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Key Words: **beginner, classroom, training, ideas, elementary, special education**

Did you ever wonder how to get your kids excited about learning vocabulary or word families? Is teaching measurements and graphing in math class getting you down? Looking for a nifty holiday gift from your class to their parents and sick of the old potted sunflowers? Want a good way to get your students reading and reacting to those stories in reading class? Have we got a session for you!

This session will help any teacher who wants to work with technology but feels unqualified. The panel of teachers will give ideas and tips on creating a technology-based atmosphere in the classroom from the physical set-up to examples of ways to use various programs and technologies within the curriculum. The team will share some of the pitfalls and successes experienced while guiding students in the use of technology.

Technologies discussed within this session will include computers, digitizing cameras and scanners, voice mail, LaserDiscs and CD-ROMs, and online communications. Elementary grades and Special Education classes will be represented.

This team is excited about passing the enthusiasm they have seen in their students onto other teachers and believes technology can enhance the learning experience of both student and teacher! So hop on board and hear about some of the great things that can happen when Teachers and Technology mix!

Project
Getting Hyper About Business and Industry

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Key Words: **HyperStudio, multimedia presentations, hypermedia, business and industry**

Hyperlinking business and industry in Le Center, MN, with the Le Center Public Schools is part of the curriculum that was developed to get the Le Center Senior High School students to work cooperatively with businesses in Le Center. The students are enrolled in a semester long class using *HyperStudio*.

Students spend time learning how to create slides for stacks, use the drawing tools, add clip art to a stack, add graphics from CDs, add *QuickTime* movies, add sound to their stacks, and to script their stacks. Students also learn about proper layout formats and techniques. During this time the students are also required to create simple stacks to apply their learned knowledge.

The main selling point of the program comes when the students work with a local business in town. Businesses that are involved in this program have given their prior approval to be part of this program, (the students are not paid to do any of this work for the business). Once the student and the business become a match, the student begins researching that business.

Students are to create a *HyperStudio* stack identifying something about the business. This stack created will then be installed onto a Macintosh computer in the place of business so when customers arrive in the establishment, the customer can sit down at the computer and search for the information they are in need of. An example of this project is one done for a local bank. The information created on the stack gave instructions on how to open a savings and checking account, the interest rates on savings bonds and CDs, how to apply for loans, and general information about the bank.

This program has helped provide another building block to better foster open communications and cooperative working efforts between the community and local school district.

Project
Lunar Base Simulation: Experimentation, Multimedia, and Modeling of Life Processes

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Key Words: **biology, NASA, ecology, simulations, experiments, botany, nutrition**

Summary of Project Goals

The national guidelines for curriculum reform and the Biological Sciences Curriculum Study (BSCS) group suggest that middle and high school biology courses should be restructured to focus more on the inter-relatedness of biological systems than on the didactic classification of organisms. The multimedia project, BioBLAST (Better Learning through Adventure, Simulation, and Telecommunications) is designed to give students academic experience through the following kinds of activities:

1. addressing a fascinating topic—based in the future;
2. conducting manageable research activities;
3. addressing challenging, real problems;
4. having support from the scientific community;
5. viewing biology as a dynamic set of interdependent systems; and
6. sharing results within a research community.

BioBLAST is currently under development by science and educational researchers at the Classroom of the Future (COTF) Program, Wheeling Jesuit College. Launched by funding from NASA in July of 1995, BioBLAST will employ NASA's most recent discoveries in the field of Advanced Life Support and Controlled Ecological Life Support Systems (CELSS) research.

The BioBLAST Scenario

BioBLAST is a six-week multimedia biology curriculum supplement that will involve students in current life sciences research at NASA. In the BioBLAST scenario, students, supplied with a limited stock of water, oxygen, food, and supplies, will travel to the moon to "live" and work at a research station. They will do diverse life sciences research, conducting hands-on and simulated experiments. Next, they will use software to design a self-sustaining, ecological system that can meet a crew's survival needs during prolonged space missions. The system must be designed to grow edible plants; capture the resultant edible nutrients, oxygen and water; and break down human and plant "waste" into materials suitable for the growth of more edible plants.

BioBLAST's schedule of activities will draw students into increasingly complex tasks as they discover interdependencies among basic processes in plants, humans, and organic decomposition. In order to succeed in their missions, students will need to learn about botany, human physiology, nutrition, and ecology within an engineering biotechnology framework. They will be supported by extensive interactive multimedia and telecommunications resources, including the ability to contact NASA scientists online.

Student Activities Lead Up to an Adventure/Simulation Experience

Module 1 introduces students to key concepts of BioBLAST. They will take a virtual tour of the lunar base and its three research laboratories: plant production, human requirements, and resource recycling. After using interactive simulators and viewing animations of biological processes in the three laboratories, each student will select, conduct, report, and assess a research proposal addressing some aspect of the CELSS challenge.

During Module 2, students will join appropriate research labs to carry out the classroom experiments described in the proposals they selected. In addition, each student will belong to a mission team—a balanced collaboration of "experts" from each of the three labs. While conducting their experiments, students will leave their lab groups intermittently to join their mission teams for CELSS design sessions. Successful CELSS designs must incorporate results from all three research labs. Students will also conduct trial runs that challenge them to solve system failure scenarios that may occur during their final run of their CELSS design.

In Module 3, students will engage in a final simulation: They will run their life support models for several (simulation!) years. Successful teams will be able to adjust the components and resources of their models to keep their human crews alive. Afterward, debriefing exercises will help students express what they learned from their experiences. Using the Internet, team members will discuss their experiences with students in other participating schools. As a culminating activity for this project, students will write their own research proposal that addresses a problem they see that yet needs to be addressed in the CELSS scenario. Students will be asked to share and defend their proposal with their mission team, class, and with their fellow researchers at other participating schools.

Teacher Involvement in Development Process

To ensure compatibility with national standards and classroom realities, development of all BioBLAST materials will involve practicing teachers. An advisory group of biology teachers from diverse schools equipped with the necessary laboratory and Internet technologies will attend workshops at the COTF facility to review design materials and test early prototype materials with their students. Back in their classrooms, teachers and their students will participate in the initial field testing and later formal evaluation of BioBLAST computer-based and hands-on activities.

Focus

25 Computer Ideas for the Classroom You Can Implement Tomorrow

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Key Words: **computer, education, classroom, Kid Pix, integration**

The integration of technology with the curriculum is the basis for our computer program at the Schools of the Sacred Heart. Classroom teachers and computer teachers work and plan together designing curricular based projects. The computer specialists keep up with the latest technology; classroom teachers keep up with the latest curriculum developments. Students create curricular related projects, while simultaneously learning computers skills. The software we prefer using is open-ended, allowing for use by many grade levels. For example, we use *Kid Pix* to teach letter sounds with first graders, and have fourth graders create graphs from scratch. Primarily, we use *Microsoft Works, Kid Pix, HyperStudio,* and *PageMaker*. Rather than teach "computer skills" with these programs we develop projects tied to the curriculum and have the students "learn by doing." When students are designing newspapers for their History class we teach the concepts of copying, pasting, formatting and page layout. These concepts are timeless and will remain useful regardless of software and hardware changes. Ideas shared in the NECC presentation are simple, yet very effective. Computer projects don't need to be complicated and time consuming for teachers or students.

Teachers are always on the look out for new ideas that can be adapted for their own classroom. Teachers at NECC want to come away with ideas that can be immediately put to use. Our presentation will offer 25 ideas integrating the computer with the curriculum. The projects will cover all grade levels and all subject areas. Teachers typically are very creative when it comes to curriculum development; however, some teachers have been slow to integrate the computer into their curriculum. Our examples demonstrate just how simple this integration can be: from identifying continents and oceans in a simple *Kid Pix* mapping exercise, to multimedia *HyperStudio* projects on the human body. Upon seeing our projects, teachers can not only use some of our ideas, but will also begin to see how to create projects of their own. The enthusiasm generated by this creative integration of the computer into the curriculum is contagious. Students and teachers are hooked!

Focus

Visions and Imagery: Part of a Young Thinker's Creative Toolkit

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Key Words: **visions, imagery, creative, toolkit, problem solving, art education**

As a new century approaches, students are being introduced to changing technologies and global communications which will influence the broadening content of the creation and understanding of art.

Art must be recognized as fundamental in the development of every child, providing a foundation and passion for interpreting life's delights, uniqueness and realities. Art education in the new millennium should promote creative problem solving which emphasizes: commitment, research, defining an idea, choosing options, idea selection, implementation, and evaluation. Art through education must also develop awareness of diverse creative processes, and support criticism, evaluation and valuing, by assisting with expression of feelings, seeking quality, and recognition of accomplishment.

Once relevancy in art education is established, it will play an integral role in the historical contributions of visual art and future planetary discovery.

Visions and Imagery: Part of a Young Thinker's Creative Toolkit is a focus session which will assist educators in traversing the "techno-unique" environment of young students making connections with hypermedia, multimedia, video and visual art.

Educators will observe clay creation animation, computer animation, video overlay, and diverse multimedia creations which integrate visions and imagery on an invisible technology budget.

Educators will experience and share projects which have touched educators across the United States, Europe, and Australia, and continue to energize audiences' perceptions of inventive technological applications.

Focus
Using the Spanish Speech Viewer II/ELLIS with Latino College Students

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Key Words: **ESL, pronunciation, Hispanic. Latino, college, speech, multicultural**

The IBM *Speech Viewer II* is a state of the art speech bio-feedback software package used by speech/language pathologists. This focus session describes how the *Speech Viewer II*s Multi-Lingual Option has been used to assist post-secondary Latino students improve their American English Pronunciation. The *Speech Viewer*'s awareness, skill building and patterning modules will be demonstrated.

In addition, the *ELLIS Master Pronunciation* CD-ROM has also been used for speech training. One of it's unique features is the capacity to describe speech sound production in 25 different languages. The Spanish language description has been most helpful to pinpoint articulation differences for Latino students.

The *ELLIS Master Pronunciation* also includes auditory discrimination, video cartoons of x-ray speech movements, and tongue twisters as well as patterned practice for conversational phrases (Speech Acts). A comparison of the English and Spanish phonology systems also helps students to focus on correct English articulation.

These computer programs have been successfully incorporated into a multi cultural community college classroom in a unique curriculum developed by the author called "Pronunciation for Academic Success."

Project
Turning the Tables: Student-Administered Professional Development

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Key Words: **professional development, training, inservice, student**

In Jefferson County Public Schools, a district of 92,733 students and 5,648 teachers, professional development has long been a monumental task. We are now "turning the tables" on this problem. JCPS is using Student Technology Leaders (STLs) to deliver technology training to teachers. District-level student employees, with the assistance of the Computer Education Support Unit, design and implement training sessions on topics ranging from hardware/software maintenance to scripting home pages on the World Wide Web. In addition, schools of all levels use the STL as technology assistants and as classroom facilitators who assist anxious teachers in the integration of technology into their curriculum.

By taking care of some of the small technology problems at the school level, these student technology leaders have allowed the Computer Education Support Unit staff to become more productive. The Student Technology Leaders set up hardware, install software, and assist in wiring computer labs.

Having the Student Technology Leader present in a professional development session brings down the trainer-to-teacher ratio and allows for more to be accomplished by the participants. Students have designed a strand of trainings to accomplish the monumental feat of training a district of over five thousand teachers and one hundred thousand students.

In addition, because students are so enthused and energetic, the district is able to move more quickly into new areas of technology like the World Wide Web. Student Technology Leaders develop and implement training for teachers, students, and the entire community on how to access, locate resources on, and author on the World Wide Web. Harnessing the students' natural curiosity and employing them as technicians has allowed JCPS to begin training a district of over five thousand teachers and one hundred thousand students on the use of the Internet.

For example, the Internet training begins with a three-hour block to expose the user to telecommunications. Topics covered in this unit are:

- What is the Internet, World Wide Web, and other related terms?
- What equipment/connections are needed to get on the Web?
- What are some interesting places to visit?

Participants visit these sites first set by bookmarks and then using addressing methodologies. The students then discuss and visit sites that present the perils of total access. These sites include samples with erroneous information, sites with objectionable information, and sites with information of no apparent value to education. Finally students demonstrate and then allow the participants to use Search Engines to locate resources on the Web. This training is offered both to students and teachers.

The second phase of training focuses on a team of students from a local school. This local school Student Technology Leadership Program (STLP) is trained on how to create their school's home page. Using a template designed by the student technicians, a Zap Shot Camera and HTML editor, teams of students from each of the local school develop their own school's representation to the world on the World Wide Web. This home page also serves as the location where teachers place their links to resources their classes will use on the Web. While this kiosk system seems rather contemptuous, it serves as a network facilitator, linking our district level web server with the individual servers at all schools participating in the project.

The next phase of training involves developing instructional units on the Web. This training is focused on the teachers, but ultimately impacts the students. During this sessions student technicians instruct participants on how to add links to their schools home page with resources that tie to the curricular unit they are studying. Time is given to unit design, resource location strategies and authentic assessment activities that can be incorporated. The student trainers co-present this unit with a curriculum specialist. The students providing the technical "know how" and the specialist provides the instructional guide.

The last phase of training is that the student technicians can be scheduled for additional mentoring at the school site. This mentoring can include hardware/software installation, one-on-one assistance, and/or large group training seminars to teams of teachers and/or students.

Focus

Special Education Resources on the Internet: Making Connections

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Key Words: **Minnesota, special education, Internet, access**

The power switch goes on. Electric circuits flow. The screen changes from gray to a multicolored display. With just a few simple keystrokes, Jayme and family are connected to the World Wide Web (WWW). Living in a small town in Minnesota could limit contacts; but, with the Internet, resources are at their fingertips. Jayme needs a new wheelchair. This mid-sized dynamo needs more mobility and community access. A quick trip to FEDWORLD...

```
>telnet fedworld.gov
>[1] FedWorld
>Name (or NEW) and password
>[G] Research, Technical, and Education Mall
>[1] RT&E GateWay Systems (Connect to Gov't
  systems/databases)
```

```
>115:ABLE INFORM (DOEdu)
>Name and password
>F File areas
>WCCHILD.F22
```

...provides Jayme's family with access to AbleData's extensive database on assistive technology where they find Fact Sheet #22 with information on Children's Wheelchairs. Other fact sheets provide information on Powered Wheelchairs <POWWHCH.F24>, Manual Wheelchairs <MANWHCH.F23>, and Informed Consumer Guide to Wheelchair Selection <WHEELCHR.ICG>. After downloading the files and printing them off, they will share this information with the transdisciplinary team that coordinates Jayme's education. An entry on the message board provides them with a chance to contact a family in a similar situation. They leave a message asking about experience with a particular company.

Once the trip to FEDWORLD is completed, it's time to check for mail messages. An e-mail awaits from one of Jayme's cousins who also has access to the Internet.... A summer reunion is in the works. Aunt Susie will check on campground accessibility. Jayme's friend from summer camp writes about using a new augmentative communication device to present a report. "It was way cool!" A note from Jayme's teacher confirms the meeting for next week and provides an e-mail address for a university professor <in%"c.macfarlane@uni.edu"> who specializes in making "low tech" assistive devices. Jayme's mom sends the professor a request for information on making microswitches for a neighbor's 4-H project. Just before signing off, a signal announces an incoming e-mail from the family on the message board... "the sales representative was great to work with and the company stayed with the timelines."

Meanwhile, at Jayme's middle school, we find Jayme's seventh grade social studies teacher, Mr. Peterson, and Jayme's case manager, Ms. Cruz, discussing Jayme's lack of peer relationships in the regular education social studies class. Mr. Peterson wonders about fostering peer relationships using technology-based projects. Ms. Cruz and Mr. Peterson search Internet using *Netscape* to find ideas for technology-based projects and research on peer collaboration and technology use. Within a few seconds they locate the US Department of Education's home page <http://www.ed.gov>. They select the publications option. Several clicks of the mouse later, the teachers locate a description of a research project on technology use. The researchers discuss the positive benefits of technology-based projects on peer collaboration, including increases in self-confidence and communication skills, and in enjoyment from helping others.

Since Jayme is already a skilled computer-user, the teachers anticipate a technology-based project will help form relationships in class and build self-esteem. Mr. Peterson does not have time to develop a personalized technology-based project, so he is excited to find web sites that meet their needs. The photographs and sound clips help to understand the nuts and bolts of the projects identified. He decides to use a project in which students collaboratively design a city of the future for their northern Minnesota location using word processing, draw, and paint software.

The scenarios described above illustrate just a few possibilities open to persons with disabilities, their families, and educational team members when the vast technological resources available via Internet become accessible.

Project

Cutting the Hype on Hypertext: Different Educational Hypertext Environments

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Key Words: **hypertext, curriculum, telecommunications Audience: All, Level: intermediate to advanced, but beginners will not be intimidated.**

Abstract

For the past two years, teachers working with staff from the Education Program of the Lawrence Livermore National Laboratory have been investigating the use of massive hypertext documents as a means to develop and disseminate science curricula developed at the Laboratory. We presented the first of these investigations at the 1995 NECC conference in Baltimore. An electronic environment that presents large amounts of information in a non-linear style, hypertext is becoming a viable environment in education. Hypertext lends itself to exploration through the free interplay of links in a web-like structure. It captures the user in an evocative way, due to its interactive nature. Hypertext can provide a springboard for group research and collaboration, because its interconnectivity allows the user or users to follow a predesigned path or one that meets the individual or group learning needs. We are using hypertext in a variety of formats, each of which possesses unique advantages and disadvantages for the classroom. Last year we discussed a stand alone applications; this year we will compare those environments with applications used in telecommunications. This presentation will give a brief history of, and a description of the nature of, hypertext, followed by a comparative discussion of the specific environments.

Besides the familiar *HyperCard* (TM), we will examine environments such as StorySpace, HTML, Microcosm, and others. We will look at each environment on the basis of 1) length of learning period, 2) appropriate audience level, 3) ease of use, 4) adaptability to subject area, 5) cost factor, 6) level of disorientation, and 7) assess and portability. This project is not now, nor will it be a commercial product or venture, though it does make use of a software product that is on the market. The Education Program is an educational outreach program of the Lawrence Livermore National Laboratory. The Laboratory is managed by the University of California, under contract to the United States Department of Energy.

Focus
Emerging Technologies and Collaborative Projects: The Syracuse University/Teachers College Living Schoolbook Project

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Key Words: **business/academic partnership, high performance computing, collaboration, high bandwidth network, Web-based, multimedia, grades 6–12**

The National Information Infrastructure (NII), popularly known as the information superhighway, holds unexplored potential for K–12 education. Students and teachers need access to high-performance computing and communications technology to take advantage of the vast array of information available. They need to expand their thinking about teaching and learning.

Clearly, schools do not have the resources in technology, expertise, or funding to effectively use the National Information Infrastructure. New relationships of collaboration between schools, scientists, education researchers, and business are necessary to provide students and teachers in K–12 schools with the skills, equipment, and support needed to access the National Information Infrastructure in a way that will enhance education.

The Living Schoolbook project is an ambitious attempt to incorporate future Education Information Infrastructure services based on the NII into elementary and secondary schools in New York state. It is a collaboration of educators from Syracuse University and Teachers College, Columbia University, computational scientists, teachers, business, and government. The overall objective of the project is to apply the best high performance computing and communications technologies and to develop and deliver educational resources that can be used by teachers and students in New York state's elementary and secondary schools.

Teachers are working with computational scientist and university educators on related multimedia web based projects. The first is the effort to create an Interactive Journey of the State of New York, consisting of terrain navigation and journeys of local areas created as class or individual projects. The second, the Network Exploratorium, consists of a collection of multimedia resources gathered from the Internet by teachers and stored on the servers of the Northeast Parallel Architecture Center.

Objectives of the Focus Session

At the time of the NECC '96 conference, we will be in the second year of a multi-year project. The Focus Session will provide an in-depth discussion of K–12 technology planning and implementation, in the context of necessary collaborative relationships enabled by wide-area networking

Presentations

After a brief multimedia presentation giving an overview of the project, four researchers working on the Living Schoolbook Project will present reports on the following topics.

The Technological Aspects of the Living Schoolbook Project

Kim Mills, NPAC, Syracuse University

The computational scientist responsible for the development of applications and caching of resources will describe the technology involved in the project. The Living Schoolbook project is designed to deliver real-time, multimedia, information on demand for use in classroom instruction in six pilot NYS schools. The project is centered on NYNEX's NYNET, a regional ATM (asynchronous transfer mode) gigabit commercial network.

The Living Schoolbook project is among the first in the nation to link schools to an ATM wide area network infrastructure. NYNET connects three schools in the Syracuse-Rome area of upstate New York, and three schools in New York City with state of the art parallel computers, databases, and large scale digital storage facilities at the Northeast Parallel Architectures Center (NPAC) at Syracuse University. NPAC is using their InfoMall partnership model of combining enabling technologies, technological and educational expertise, and state of the art facilities to develop applications for the Living Schoolbook project.

The Response of Teachers to New Technology in the Living Schoolbook Project

Brenda G. Weikel, Syracuse University

An education researcher will report the preliminary findings of a study of teacher talk during work sessions for the project. The study involves discourse analysis of small groups work, peer interviews, and work sessions at the computers. Data collection is in the form of audio tapes which will be transcribed and coded for types of comments, the use of technological language, and signs of acceptance of rejection of new ideas about teaching and learning using the technology. Relationships within teacher teams and among the teachers and university educators and computational scientist will also be examined. The author will focus the analysis of discourse on the process of teacher accommodation of the technology.

The Development of Assessment for the Living Schoolbook Project

Barbara A. Shelly, Syracuse University

The SU Education Project Coordinator will describe the development of a multilevel plan of assessment. The focus will be on describing the results of the initial field tests and the ongoing formative assessment of project develop. Some of the questions for assessment that relate to the project's impact on student learning include:

- How is the LSP technology actually used by the students in the classroom?

- In what ways do the students utilize the resources available on the network?
- What is the impact of new relationships forged between students, teachers, and scientists on teaching an learning?

This report will outline the process of developing meaningful assessment of a complex project under development.

Lab versus Classroom Implementation Models in Living Schoolbook and Harlem Environmental Access Project Schools

Bram Moreinis, Institute for Learning Technologies, Teachers College, Columbia University

The Teachers College Project Coordinator will discuss technology planning and implementation strategies for deploying computers to labs and classrooms with varying student:computer ratios, and how these decisions affect learning activities.

As technology planning and curriculum design partners with 8 schools in two K–12 network testbed projects (Living Schoolbook and HEAP), the Institute for Learning Technologies of Teachers College, CU, has accumulated significant experience in preparing schools for planning, installing, and implementing school computing infrastructure. The implications of various planning and deployment strategies will be discussed in this context, with equal attention to the managerial, cultural, and pedagogic outcomes of these choices. The Ralph Bunche School, The School for the Physical City, and The Dalton School will be discussed, as will five Harlem schools in various stages of "learning about technology" and "teaching with technology."

Society

A Teaching Technique for Time Warp Simulation (SCS)

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Key Words: **simulation techniques, teaching techniques, time warp, distributed processing**

Basic elements of discrete event simulation are reviewed. The common approaches to discrete event simulation are described briefly. Alternatives for distributing a discrete event simulation are reviewed. From these, the concept of a distributed simulation is developed. With this background, one can explore the options for distributed simulations.

The technique used involves a static partitioning of the model across the machines. Each machine then does a conventional simulation of the portion of the model resident on that machine. Each machine, when faced with scheduling activities that are performed on another machine, sends a message to that other machine requesting the desired action. Each machine maintains its own local clock.

The key issue with this technique is assuring that events get processed in the correct order. There are a variety of mechanisms used for assuring correctness and absence of deadlock. In 1988, Paul Reynolds described conservative distributed simulation as a design where no machine could ever receive a message in its logical past. Several techniques exist for assuring conservative distributed simulation will not deadlock. These techniques include Chandy-Misra's null messages, Peacock's link time, Lubachevsky's bounded lag, and algorithms adapted from the concurrent programming arena to deal with distributed deadlock.

Time warp simulation, as first described by David Jefferson, on the other hand, allows a machine to progress even though it may receive a message in its logical past. Such messages are called stragglers. In other words, this technique is optimistic, rather than conservative. For this technique to work, one must be able to restore the state of a machine back to some point before when the straggler arrived. The machine can then (having warped back) cancel any side effects, and proceed with the simulation.

Warping back is not as expensive and clumsy as it might appear. Although the technique involves wasted computations, wasted computations occur only when the machine would have otherwise been blocked.

Each machine maintains a local time, a current state, an input queue or messages (including some that have already been processed), an output queue of messages (including some that have already been sent) and a state queue that holds copies of the state at earlier times.

The simulation algorithm is straightforward except copies of earlier messages (both input and output) are saved and checkpoints of earlier states are saved. There are two performance issues here. The more often one takes checkpoints, the faster one can roll back. Faster warp speed is achieved at the expense of increased storage for checkpoints. Also, one must bound how far back a machine is allowed to warp.

When a straggler arrives, one must warp back to the state of the latest checkpoint taken at a time before the straggler's arrival, and restart the simulation from that point. Now cancel the side effects by canceling all the messages that were sent out after the time that you have warped back to. This is called sending out anti-messages. Then resume simulation from that point in time and the former straggler will be processed in due course. Unfortunately, this technique leads to a phenomenon called cascading rollback, where the anti-messages cause other machines to roll back as well.

Cascading rollback can be avoided by noting that any events between the time warped back to and the straggler arrival time will do precisely what they did before the straggler arrived as the straggler arrives in their future. Hence, these events will send out precisely the same messages that they sent before. Therefore it is not necessary to send anti-messages. This involves a coast forward phase that reperforms the state changes of those events that occurred between the checkpoint and the straggler's arrival time. This will not involve sending the messages associated with those events because the messages have already been sent.

A machine receiving an anti-message does one of two things, depending on the time of the anti-message. If the anti-message cancels a message scheduled to be performed in the future, the two messages cancel each other and no further action is required. Otherwise, the anti-message cancels an event that has already been performed. Hence, one must not only cancel the message, but one must also warp back to before the anti-message time.

In the nearly synchronous case, there are few rollbacks. If one cancels messages in time order, there will be minimum interprocessor traffic and minimum rollback. One can sometimes improve performance by using a technique called lazy cancellation. With this technique, message sin the logical future after a time warp are not immediately canceled with anti-messages. Instead, one waits until the time the message was sent to send out the anti-message. If the message still gets sent, even taking the straggler into account, then there is no need to cancel it.

The only unresolved issue is how much checkpoint information and old messages must be saved. If one defines minimum global time as the smallest of the local times on any machine, it should be obvious one need not save anything earlier than the last checkpoint before minimum global time. The literature contains several algorithms for determining minimum global time.

Focus

Is There Value in School Versions?

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Key Words: **school versions, software, K-12**

How can school versions assist with classroom instruction and integration? Explore, discuss and evaluate the topic of school versions in classroom integration. Are these materials a value to the teacher and are they being used? In this session, we will explore the various formats available with school computer materials that are created for classroom integration. Some software publishers produce beautifully designed teacher's guides which contain content integration suggestions, well-developed lessons, black-line masters, charts, graphs, scope and sequence, textbook alignment, national guideline correlation and more. Examples of quality materials will be provided and displayed. Some of the questions and topics explored will be:

- What is a school version?
- How to use a Teacher's Guide in the classroom.
- Where can I find lesson plans that integrate software into the curriculum?
- Which publishers consistently offer school versions?
- Are there materials available on the Internet?
- Are there reviews and evaluations of teacher's guides?
- What are copyright guidelines for using lesson plans?

Focus

Government Online: Educational Attractions Along the Information Superhighway

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Key Words: resources, online, government, federal

In an information-rich world, it's important to provide materials and resources to the education community and others concerned about education. Whether it's the verbatim text of a recent law, current grant opportunities, speeches and testimony of the Secretary of Education, brochures for teachers, parents, and communities, or classroom resources, the Department of Education is committed to providing access to public information, and in particular, providing access online. This demonstration will show participants how to get education-related information from the Internet.

Among the wealth of information that is available on the Internet, there are documents, data, and resources provided by the federal government. This presentation will show participants an array of information that is available on government World Wide Web, Gopher, and FTP sites, government-funded locations, and other sites that provide resources for teachers and students.

We will begin at the Department of Education's Online Library. The Department's online services provide access to a rich collection of education related information including funding opportunities, legislation, speeches, survey results, calendars, research findings, and full-text publications, such as *Prisoners of Time,, All About ED Grants, A Researcher's Guide to the US Department of Education*, and Goals 2000 and School-to-Work documents. This presentation will demonstrate what resources are available through the Department's World Wide Web, Gopher and FTP services and how easy it is for you to find them online.

In addition to the materials available at the Department of Education, there are many resources developed all around the country through funding from the Department. We will tour such sites as AskERIC, where there are teacher-created lesson plans and where anyone can ask any education-related question posed via e-mail and get a response in plain English, guaranteed within 48 hours. And its popularity is growing—AskERIC answers 70% more questions in 1995 than it did in 1994.

We will visit a related service, the National Parent Information Network, which is the largest Internet resource for parents, providing high quality information devoted to child development, childcare, education and parenting. NPIN is the ultimate resource for posting and responding to parents' questions about education on the Internet.

The Educational Resources Information Center (ERIC) runs a nation-wide network of 16 clearinghouses and adjunct sites that develops, maintains, and makes available the world's largest education-related database. Aside from AskERIC, which we visited earlier, several other ERIC clearinghouses run Internet web sites. We will select an assortment of valuable sites to visit.

Then we will tour the Eisenhower National Clearinghouse for Mathematics and Science. As time permits, we will travel to National Research and Development Centers around the country, such as the National Center for Research on Teacher Learning, located at Michigan State University. This center examines various approaches to teacher education, including pre-service, in-service, and alternative and induction programs. The goal is to further knowledge and understanding of the purpose of teacher education, the character and quality of teacher education, and the role of teacher education in teacher learning.

We travel to the National Center on Adult Literacy, located at the University of Pennsylvania. Its mission is to enhance the knowledge base about adult literacy, improve the quality of research and development in the field, and ensure a strong, two-way relationship between research and practice. This center conducts applied research and development and dissemination of the results and publishes a variety of documents.

Another set of locations partially sponsored by the Department of Education are the Regional Educational Laboratory Network sites. Almost every one of these Regional Educational Laboratories maintains information that is available online. Some of the labs have web pages, and the others have gopher sites. These sites are the educational research and development sites for the Department. We begin our tour with the Regional Educational Laboratory map and will travel to several locations around the United States.

Then we will tour web sites of other Federal Agencies, such as NASA's education resources, the US Geological Survey, and the National Science Foundation web site. All of these provide information that is useful for educators.

In addition, we will visit selected State web sites, and finally, we will show how to find examples of student and teacher web sites around the country.

Panel

Beyond Book Reports: Towards Authentic Computing for Children

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Key Words: **technology planning, constructivism**

Although computers are being used by schools in wonderful ways, they are most often used for publishing paper or screen-based reports. Computers are first-and-foremost computational devices—an idea often lost on school technology planning.

Many traditional disciplines have been forever transformed by computer technology. Students need to understand these advances and may even contribute to new ones. The panel will explore ways in which the computers may be used to maximize student learning potential by being used as intellectual laboratories for the personal construction of knowledge.

Panel

The Call of Down-Under: What Australian Schools Learned When Every Student has a Laptop

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Key Words: **laptops in classrooms, school change, administrative issues, teacher education**

The members of this panel discussion have years of experience in Australian schools in which every student has a personal laptop computer. Come hear the tales of these pioneering teachers and learn what they have learned about learning, teaching, and curriculum in the technology-rich future of today.

Project
Constructing Geometric Knowledge by Building Your Own Geometry Toolkit

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Key Words: **math, constructionism, cooperative learning, teacher education, programming**

This session will share an activity designed for middle and high school in which students express their geometric knowledge by collaboratively constructing their own geometry toolkit. The toolkit is similar in function to software like *The Geometers' Sketchpad*, but allows students to truly understand the math behind the tool by designing the software themselves. This session will share ideas and materials for getting started. *MicroWorlds* is used as the design environment.

Focus
In Search of Powerful Ideas: Reflecting on the Role of Technology in Teacher Education

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Key Words: **teacher education, planning for the future, administrative issues**

Increased access to technology and professional development are critical if computers are to be used more constructively in classrooms. Schools and districts have much work to do in this area and so do universities. While preservice education is not doing enough to prepare new teachers for the successful implementation of educational computing, graduate school programs have their own problems.

If educational computing is in fact a legitimate discipline, then universities have an obligation to prepare their students for the educational issues and societal implications associated with implementation. This session will explore how universities can identify the powerful ideas of educational computing and turn those ideas into practice in their teacher education programs.

Project
Explore, Discover, Communicate! Making Elementary Social Studies a Cross-Curricular Adventure

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Key Words: social studies, geography, graph, math, language arts, elementary

This session will feature versatile tools that encourage teachers to integrate social studies, math, language arts, and other subject areas. The presenter will:

- Propose ways to create learning environments that encourage exploration, cooperative problem solving, and communication
- Suggest ways to combine the teaching of skills, concepts, and content
- Highlight tools that encourage cross-curricular integration
- Provide sample lessons and activities that work in real classrooms
- Share sample student projects

A variety of tools will be featured including the following:

- A first look at an innovative geography program that teaches important map skills such as the use of symbols, scale, direction, and the relationship between two-dimensional maps and three-dimensional real world environments. Social studies, math, and language arts applications will be featured.
- An elementary graphing program that helps students (1) make the transition from graphing with manipulatives to graphing in the abstract, and (2) understand how the same data can be represented in differently as table, picture, bar, line, and circle graphs. Social studies, science, math, and language arts applications will be featured.

Project
Balloonin' USA: Liftoff for Learning

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Key Words: telecommunications, classroom student project, online teacher training, curriculum integration

The world's first interactive hot air balloon trek across the United States has touched the lives of students, teachers, and communities throughout the United States. Since the initial flight from Douglas School District in September, classrooms across the country are filled with learning experiences using telecommunications and active learning experiences. It is easy to get caught up in the excitement of hot air ballooning, but from the beginning this project was envisioned to focus on students and learning. As a result, several curriculum pieces are in place for the continuation of the flight. Subscribers initially received a packet of print materials which included curriculum "teasers" for a variety of grade levels and content areas. These were offered as catalysts for brainstorming additional student experiences as pilot Kevin Kuehn continues his journey.

Telecommunications plays a major role in the development of this project with students and teachers participating via the Internet in a variety of ways. From each visitation site Kevin posts scientific data, impressions, photos, and news of the day in a "read only" file called *Flights & Sites*.

Three Balloonin' USA student listservs are currently in operation. Each listserv has a different objective and name.

- "Kid Connections" is a personal interaction forum. Discussions and tasks in this listserv change and evolve as the project continues.
- "Kid Discoveries" is a listserv focusing on science, technology, and society issues. It is here that students might share the results of experiments, explain inventions or innovations, or pose questions about the technical aspects of ballooning. Periodic challenges are posted by the Balloonin' USA staff.
- "Kid Expressions" provides a forum for electronic publication by students. In the initial activity of this discussion group, students put their thoughts about the wind into prose or poetic form. Creative endeavors continue to be expressed and shared here.

Action Research and technology skill building were at the heart of the teacher component of Balloonin' USA Participants registered for college credit courses conducted entirely via electronic networks. As a group they studied issues related to the design and implementation of online projects, including the role of teachers, students, instructional practices, and assessment and fair use policies. Lesson plans that incorporate telecommunications were generated and shared. And, out of necessity, they learned skills necessary to use telecommunications.

As Kevin expands his travel itinerary, the curriculum and learning experiences of students and teachers expand also. New projects emerge and mature, new questions are posed, new knowledge gained, and new horizons realized. Balloonin' USA is truly an opportunity to take flight from current classroom practice and embark on a high-flying learning adventure.

Project

Learner-Centered Philosophy to Guide Design/Delivery of Distance Education

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Key Words: **distance education, distance delivery, student-centered instruction, learning at a distance**

Designing a system to deliver electronic distance education is a complex organizational effort. The many levels of detail involved EDE programs require consistency in decision making. Unfortunately, decisions are often dictated by circumstances such as budget or the desires of sponsors. An alternative is to commit to a guiding philosophy which allows decision-makers to remain consistent and autonomous. A learner-centered philosophy can serve this purpose and insure that high quality instruction is received by students. This presentation will offer a definition of learner-centered philosophy and provide examples of how it can be used to guide decisions at all levels of an electronic distance education program.

Many providers of instruction such as universities, businesses, and public education systems face increasing demands as ever-growing populations require more knowledge, skills, and certifications to stay current in an information age. Electronic distance education (EDE) is a rapidly expanding means of providing instruction to audiences which previously had financial or logistical difficulties getting the same instruction. Although EDE can be a very effective way of reaching greater numbers of students, the provider must insure that the quality of the instruction remains high despite the potential limitations of distance delivery. An important way of insuring quality is to take a learner-centered approach to the design and delivery of electronic distance education. Not only does a learner-centered approach alleviate the shortcomings of some traditional methods of instruction, but it also takes advantage of the unique opportunities offered by EDE to deliver exceptionally good instruction.

Electronic distance education can include a wide variety of scenarios, but this presentation will center on two important characteristics. First, the instructor and students are separated by a physical distance and technology bridges that distance (Willis, 1993). Second, distance education involves two-way communication between instructor and students and technology provides the means for that communication (Garrison, 1989). Electronic distance education uses telecommunication technology to provide real-time interactive communication links between the instructor and students. While these statements can help categorize programs, they only begin to describe the scope of EDE.

References

Alcorn, B., & Wittgen, A. (1990). The authority to think: The student centered classroom. Contemporary Education, 61(2), 91–93.

Dick, W., & Carey, L. (1990). The systematic design of instruction, third edition. Harper-Collins Publishers.

Freire, P. (1980). The problem-posing concept of education as an instrument for liberation. In Steiner, E., Arnove, R., & McClellan, B.E. (Eds.), Education and American Culture (pp. 387–398). New York: MacMillan Publishing Company, Inc.

Garrison, D.R. (1989). Distance education. In Merriam, S.B., & Cunningham, P.M. (Eds.), Handbook of Adult and Continuing Education (pp. 221–232). San Francisco: Josey-Bass Publishers.

Heinich, R. (1991). The proper study of instructional technology. In Anglin, G.J. (Ed.), Instructional Technology: Past, present, and future (pp. 259–265). Englewood, CO: Libraries Unlimited, Inc.

Holloway, R.E., & Ohler, J. (1991). Distance education in the next decade. In Anglin, G.J. (Ed.), Instructional Technology: Past, present, and future (pp. 259–265). Englewood, CO: Libraries Unlimited, Inc.

Knowles, M.S., (1970). The modern practice of adult education; Andragogy versus pedagogy. New York: Association Press.

Muggli-Cockett, N.E., Christenson, J.C., Boman, R.L., Bowman, B., Walters, J.L., & Taylor, W.R. (1992). Preparing and implementing an animal science course for distance education at Utah State University. Journal of Dairy Science, 75(11), 3257–3260.

Willis, B. (1993). Distance education: A practical guide. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Wolcott, L.L. (1993). Faculty planning for distance education. American Journal of Distance Education, 7(1), 26–36.

Paper

Whole-Language Strategies for Integrating Technology into Language Arts

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Key Words: **language arts, whole language, strategies**

Abstract

Learner-based software has tremendous potential to support a whole-language approach to instruction. These include creating risk-free learning environments where students actively take responsibility for their learning. Using technology can result in student empowerment and can provide students with opportunities to apply skills in meaningful ways. Strategies are presented which were implemented with elementary students to produce the dramatic results that research clearly points to.

Introduction

Literacy is a key factor for being accepted into society. However, many students around the world live in homes where, for a variety of reasons, literacy is not supported. Consequently, children face greater challenges to acquire literacy skills and teachers face greater challenges to provide them (Hochella, 1994). Rickelman and Henk (1990) asked what reading teachers can do to ensure that their students have needed competencies to succeed in the 21st century. To prepare students, they strongly recommended that teachers educate children to be literate and technically competent. How can this be done?

To increase literacy levels, many teachers have created learning situations that reflect the whole-language approach to instruction as described by Goodman (1992).

> The teacher invites learners in a variety of ways to participate in relevant and appropriate learning experiences. It does not mean that the teacher has predetermined everything that will happen; in fact, the teacher often initiates long term arrangements or structures which will lead to pupils taking as much responsibility as possible for their own learning and their own classroom. (p. 359)

Recently, language-arts teachers have discovered that learner-based software has tremendous potential to support a whole-language approach to curriculum and instruction. Learner-based software encourages students to focus on process rather than product and shifts the locus of control to the student (Bull and Cochran, 1991). This creates a three-way interaction between the teacher, computer, and student, and changes students' perspectives about the learning process. These interactions increase students' self-esteem, permit them to actively advance personal literacy levels, and promote the types of learning experiences described by Goodman above.

This article offers proven strategies to integrate technology into the language-arts curriculum and instruction and the benefits for doing so. All strategies were developed and implemented on Macintosh computers, but will also work on other platforms.

Benefits for Integrating Technology Into Language-Arts Instruction

Creating a Risk-Free Learning Environment

There are many benefits of integrating technology into language-arts instruction using a learner-based approach. The first focuses on creating risk-free learning environments where students are immersed in textual experiences and are free to experiment with language in creative ways. In such environments, instruction is based on individual students' strengths and weaknesses. Students are encouraged to think and act on their own: to collaborate, make choices, and test predictions. Students are engaged in activities that present complex problems with multiple solutions (David, 1991), see results based on their own strategies for learning, and enjoy successful school experiences (Wang & Palincsar, 1989).

Increasing Student Empowerment

The use of technology in a learner-based classroom increases student empowerment by providing them with opportunities to develop confidence and become aware of their own expertise. Students are encouraged to shape and develop their own learning tasks by taking risks and collaborating on projects. In studies of secondary students who were using computers to complete writing assignments, Fisher (1989) found that student empowerment increased when activities required problem solving and other higher-order cognitive behaviors. In a two-year study of secondary students who were using computers for writing projects, Tierney (1989) noted, "When using technology, students were more actively involved in designing and building curriculum projects and hence more responsible for constructing their own knowledge" (p. 14).

Practicing Skills in Meaningful Contexts

The use of technology also provides students with opportunities to apply and practice skills in meaningful ways. Becker (1992) noted that if the use of computers was woven integrally into patterns of learning and instruction, the curriculum was given meaning. Other researchers (Graves, 1986; Atwell, 1987; Hansen, 1987; Calkins, 1991) have reported that students read and write with greater depth and accuracy when real audiences are involved. Riel (1986) found that many times students were asked to write without concern for purpose or audience and that writing improved when students understood their purpose for writing.

Cohen and Riel (1989) found that when writing was presented in this manner, it was not viewed as an act of communication, but rather as a demonstration of skills. They reported that when writing to real audiences, "students paid more attention to the informational content and clarity of their writing" (p. 159). Harris (in press) found that when writers felt a sense of connection to their audience, their focus became more personal and the length of compositions increased.

Hiebert's (1989) findings indicated that compositions written by third-graders on computers seemed to be more focused and elaborate. "Stories had more complicated plots and included more dialogue, suggesting that students tended to take more risks when writing with computers" (p. 13). Perhaps Hansen (1987) stated it best, "Regardless of the format, children can see benefits from their written work when it is no longer only an assignment" (p. 139).

Increasing Interest in Reading and Writing

Informal observations of classrooms in Louisiana (Stuhlmann, Taylor & LaHaye, 1995) suggest that students' attitudes toward reading and writing as well as their performance in these areas improved beyond grade level expectations when computers were a part of the language-arts curriculum. These findings are supported by Newman (1989) who reported improvement in attitudes and performance of middle school students toward writing and language development when they corresponded with cohorts through a "computer pals" project.

> These students self-esteem has improved considerably. Other students in the school now often ask them what they're writing about or about the messages they've received. The responses from their computer-pals makes them feel competent. (Newman, 1989, p. 795)

Strategies for Integrating Technology into Language Arts

Simple graphics and drawing programs often can be used to introduce students to technology. Engaging software, such as *Kid Pix 2*, allows students to be creative, productive, and successful with a minimum of concern about the intricacies of the computer system.

One good starting activity involves using the Color Me option of *Kid Pix 2* to present students with pictures to color or "fill in" using paint tools. The students learn to manipulate the mouse and work with simple graphical interfaces. *Kid Pix 2* offers a variety of colors and patterns so that students can express their individuality. The friendly software and colorful results are so engaging that even the most reluctant student is immediately "hooked" on technology and ready to tackle bigger challenges!

Once students have colored the drawings, they then use the text options to title their creations and given themselves credit as artists. They can also insert special graphics stamps of objects into the picture to enhance their vision of the theme of the picture.

Using elementary drawing and painting tools is an excellent way to get students started out with technology. Similar tools are embedded into many software programs. Students will easily recognize these tools and readily use similar tools through these activities as they encounter and explore new software. Through this activity, students learn both technology skills and language skills and acquire confidence to move onto greater challenges.

Mother Goose Illustrations

Many software packages now include options for producing slide show presentations. Students use graphics and drawing packages and text to express meaning on slides. These slides are then organized into a presentation which often may include student-produced sound effects and colorful transitions between slides.

Kid Pix 2 has an inventive slide show component. The slide show is first shown as a series of moving vans. The back of the truck holds a picture. Buttons on the base of the truck allow students to select a picture, add a sound effect, and choose a transition.

One activity to get a class involved in a literary production is to have a group exercise to illustrate a favorite story or fairy tale. In one case, students were grouped into pairs to produce slides to illustrate the story of the famous egg, Humpty Dumpty. Each group was assigned a particular line, such as "Humpty Dumpty had a great fall" or "All the king's horses," to illustrate. Students were introduced to the drawing tools such as rectangles, boxes, lines, and fill tools in the software. The also knew how to use colors and graphic stamps from previous activities. Each group was given only a short time (15 minutes or less) to create their slide. The teacher created the slide show, first saving each picture to the hard disk and then dragging a copy to a floppy disk. Pictures were given names to represent the action on the slide such as Great Fall, or King's Men.

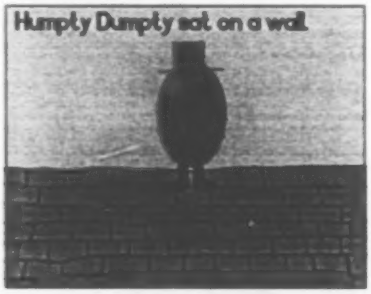
Humpty Dumpty sat on a wall

Figure 1: Humpty Dumpty Slide Show

Once all of the slides were collected, the teacher went to a central computer with a display. The students then had a part in assembling the show. The first truck was activated, and students chose the correct picture for the slide from the menu of items on the floppy disk. As the picture was selected, the group that designed the slide was

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offered the opportunity to come to the front and record a sound effect. Often, they enlisted others for this or involved the whole class. The slide designers also selected the transition to the next slide.

The class looked on with great excitement as the icon was selected to play the show. At the end, there was thunderous applause and a group of students with great pride in themselves and what they were able to accomplish.

This activity can be used in a variety of contexts, including depicting famous events in history or illustrating special events. For instance, groups could produce slide shows about celebrations in the area, including a Mardi Gras parade complete with floats, Black History Month, St. Patrick's Day, or "What I am Thankful For" (for Thanksgiving Day).

Slide Show Book Reports

Once students have mastered drawing and expression using graphics and text, they can then develop more involved personal projects that illustrate synthesis of learning and language. An excellent project for elementary language arts is the production of slide show book reports.

Students used slide show software to capture the essence of books that they had read. Students were challenged to produce shows of 5–10 slides that told the story or theme of their books. Using software such as *Kid Pix 2,* they included sounds or read portions of their text for emphasis. They also used the special "Wacky TV" movies included in *Kid Pix 2* within their slides for animated effects.

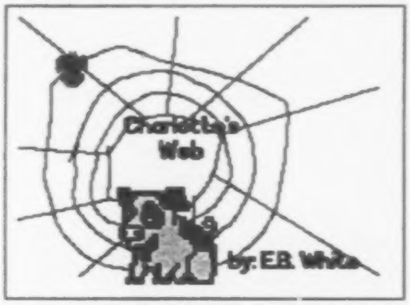

Figure 2: *Charlotte's Web* Slide Show
By Kyle, Grade 4

This activity challenges students to use higher cognitive skills to encapsulate their thoughts and organize them into a presentable format. They must also then consider the complexities of representing the concepts using the computer.

This was an excellent time to introduce students to using special peripheral devices such as scanners and QuickTake cameras. Students scanned in images, often characters or animals found in their books, and used these scanned images in their shows.

In the classes where this strategy was used, slide show book reports added a new dimension to reading. Students became excited about new books by seeing the shows that others produced. They were able to convey their thoughts in ways that were far more appealing than a pencil and paper report, and far more rewarding.

Authors in Action

There are several learner-based programs on the market designed to strengthen and develop writing skills. For example, *Easy Books* is a program designed for students to write and illustrate their own books. Students illustrate their books using the stamp tool to choose from those pictures housed in the program or have the option of incorporating pictures from other software programs into their stories.

A fifth-grade class of at-risk students, many of whom had never even seen a computer before, used this program. At first, the students were frustrated by their lack of typing skills, but before long, many students were well on their way to writing the great American novel. Like great novelists, students wrote from personal experiences. Fred, age 10, wrote a 54 page book entitled, *What I Think Mrs. Brumfield (the teacher) is Going to Tell my Mother and Father.*

Students then wrote their autobiographies, and the QuickTake camera was used to digitize their pictures into their books for pages entitled "About the Author." This created a sense of ownership and increased the students' perceptions of themselves as writers.

Poetry Alive!

The mere mention of the word "poetry" often produces groans from elementary students. Fourth-grade students were asked to write a poem called a "Wingspark." The poem supposedly was developed by an elementary class at Wingspark Elementary School. A Wingspark has five lines and follows this format:

```
I dreamed
I was (a noun)
Where
Describe an action
How
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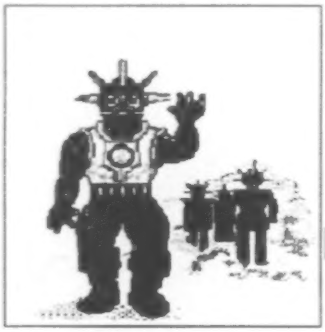
Through the use of *The Writing Center*, a program designed to easily incorporate text and graphics, students were able to use their imaginations to create some very original poems as illustrated in the example below.



The Alien
By Megan. Grade 4

I dreamed
I was an alien
In Outer space
Driving a spaceship

Wrecklessly!

Figure 3. Alien Wingspark

The format of the Wingsparks and the ease of incorporating graphics with text made this writing assignment interesting and fun. Students were delighted with their poems and thoroughly enjoyed using computers to compose them.

Onward and Upward

Several strategies have been presented for integrating technology into language-arts instruction. The strategies are designed for learners to be as successful as they can be, but also to allow for great diversity. The activities often can be used with students working independently or in groups. They are designed so that each student can achieve some degree of success and gain an appreciation for his/her role in the product that was produced.

There are many other types of language-arts software packages that teachers are using successfully. One particularly effective type of package emerging at present is story starter software. These are used to provide ideas, pictures, or thoughts for stories. Often they contain colorful graphics to use to illustrate stories.

Another activity is the production of class or individual newsletters. This can be done with specific publishing software, such as *PageMaker*, for the more advanced students. Students in the classes in Louisiana created excellent newsletters using *The Writing Center*. Others use integrated packages such as *ClarisWorks* for this purpose. Teachers just starting out with newsletters can have enormous success sticking with standard packages which facilitate easy integration of graphics and text rather than investing in specialized publishing packages which may receive limited use and stretch precious software budgets.

For most of the strategies, some specific software was mentioned. All of the activities involve common types software that can be found under many names. Thus, teachers searching for software to use for specific tasks need to be concerned with the function that it will serve rather than specific titles. Careful evaluation and consultation with other teachers who are also using technology will help educators select that software that is best suited for their particular situations.

The activities described in this paper are fundamentally sound for learners of all ages. Teachers will be able to determine when students are ready to move onto more sophisticated multimedia and hypermedia applications or more involved exploration of telecommunications resources.

The real message is that language-arts teachers now have an abundance of excellent learner-centered software that they can use within the language-arts curriculum. The challenge now is to develop, produce, and disseminate models of practice that are suitable for diverse student populations and cultures which are effective, practical, and stimulating for the learners of tomorrow.

Conclusions

Research and practice have both shown that learning is enhanced when children find it meaningful and are given an active role. In the language-arts area, students are particularly motivated when they are communicating or producing for a real audience rather than for a grade. Teachers can use a variety of technology tools to develop a whole-language approach to learning that meets all of these needs.

In the school of the future, technology and language arts will be integrated together. Students rarely receive instruction in technology for technology sake, but rather in the context of the needs for the particular curricular application that they are undertaking. The result will be students who are positive about both language arts and technology and who have the fundamental skills in both that they will need for future education and lifelong learning.

References

Atwell, N. (1987). In the middle: Writing, reading, and learning with adolescents. Portsmouth, NH: Heinemann.

Becker, H. (1992). How our best computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. Unpublished manuscript, University of California, Irvine.

Bull, G., & Cochran, P. (1991). Learner-based tools. The Computing Teacher. 18 (7), 50–53.

Calkins, L. (1991). Living between the lines. Portsmouth, NH: Heinemann.

Cohen, M., & Riel, M. (1989). The effect of distant audiences on students' writing. American Educational Research Journal, 26 (2), 143–159.

David, J. (1991). Restructuring and technology: Partners in change. Phi Delta Kappa, 73 (1), 37–40, 78–82.

Fisher, C. (1989). Student empowerment: The influence of high computer access on student empowerment. An exploratory study of the Nashville ACOT site. (Report No. IR 014 192). Cupertino, CA: Apple Classroom of Tomorrow Advanced Technology Group Apple Computer, Inc. (ERIC Document Reproduction Service No. Ed 316 199).

Goodman, K. (1992). Why whole language is today's agenda in education. Language-arts, 69 (5), 354–363.

Graves, D. (1986). Writing: Teachers and Children at Work. Portsmouth, NH: Heinemann.

Hansen, J. (1987). When Writers Read. Portsmouth, NH: Heinemann.

Harris, J. (in press). Electronic impersonations: Changing the context of teacher-student interaction. Journal of Computing in Childhood Education.

Hiebert, E. (1989). Writing: A research-based writing program for students with high access to computers. ACOT Report #2. (IR 014 193). Cupertino, CA: Apple Classroom of Tomorrow Advanced Technology Group Apple Computer, Inc. (ERIC Document Reproduction Service No. Ed 316 200).

Hochella, J. (1994). Single-case study of benefits for reading and writing derived from Elementary Books (Virginia's PEN). Unpublished manuscript, University of Virginia Charlottesville.

Newman, J. (1989). Online: From far away. Language-arts, 66 (7), 791–797.

Rickelman, R., & Henk, W. (1990). Telecommunications in the reading classroom. The Reading Teacher, 43 (6), 418–419.

Riel, M. (1986). The computer chronicles newswires: A functional learning environment for acquiring literacy skills. Journal of Educational Computing Research, 1 (3), 317–337.

Stuhlmann, J., Taylor, H., & LaHaye, S. (1995). Using technology to provide authentic learning experiences for preservice teachers. Technology and Teacher Education Annual, 1995, Proceedings of SITE 95, San Antonio, TX, 273–277.

Tierney, R. (1989). Student thinking processes: The influence of immediate computer access on students' thinking. First- and second-year findings. ACOT Report #3. (IR 014 194). Cupertino, CA: Apple Classroom of Tomorrow Advanced Technology Group Apple Computer, Inc. (ERIC Document Reproduction Service No. Ed 316 201).

Trelease, J. (1989). The New Read-aloud Handbook. New York: Penguin.

Wang, M., & Palincsar, A. (1989). Teaching students to assume an active role in their learning. In M. Reynolds (Ed.), Knowledge Base for the Beginning Teacher (pp. 71–84). Oxford: Pergamon Press.

Project

ModelNets: Portraits of School and District Networking

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Key Words: **planning, policy, infrastructure, impacts**

ModelNets: A National Study of Viable Models of Networking Technology in K–12 Education was commissioned by the US Department of Energy in late 1994. Designed by Energy, the study employed a team of approximately 30 researchers from the 10 US Department of Education's Regional Educational Laboratories. This team of researchers worked with researchers and evaluators from the Los Alamos (NM) National Energy Laboratory, the University of Tennessee, and several Department of Education National Centers.

The objective of the ModelNets project was to find models or patterns of development of effective district-wide education data networks. The basic assumption of the study was that some percentage of school districts across the country had implemented data networks and that these networks could be classified according to those that were effective and those that were not. It should be noted that the ModelNets study set out to find school districts where network technology had been effectively implemented. It was not a controlled study in the sense that the researchers did not develop the networks in the studied districts.

The survey nature of the ModelNets project resulted in a somewhat mixed bag of study subjects. First and foremost, the networks selected for study were largely incomplete efforts. In the vast majority of cases, the "jury was still out" on whether or not the network existed at the district level or (more often) would continue to exist for the foreseeable future. Secondly, the networks studied varied considerably as to their usage and scope. Some networks were mostly in-building LANs, while others were WANs which covered great distance and connected many individual schools. Another important difference related to network usage. Some of the study networks were restricted to predominantly administrative use. Others provided large numbers of student and teacher accounts. Still others were community networks which connected parents, senior citizens, local government, and businesses.

Summary Findings

As will be discussed in this project presentation, the ModelNets study examined policy, teaching and learning, and infrastructure aspects of school and district networks. The following trends were found when looking across the study sites:

- Most of the ModelNets sites that were actively using and developing educational networks made use of innovative instructional uses and pedagogical approaches—both including the use of technology and without the use of technology. This is to say that the use of network technology is a function of innovative teaching and learning practices. Those educators who are not innovators are less likely to employ the types of practices that network technology enables. While this seems rather obvious, it nevertheless bears mentioning when considering why certain educational technology efforts are more successful than others. Technology cannot simply be dropped into the school environment without a prior commitment on the part of the school or district to truly changing the way teachers teach and students learn.

- The existence of suitable and sustainable funding was important for network implementation and operation. Network funding was often the result of bonds, grants, partnerships, or gifts, although with the exception of partnerships, most of these sources are not sustainable. Virtually all of the studied networks were struggling to develop funding sources that would not come or go or fluctuate dramatically from year to year.
- A technology/networking champion with vision and authority to make change was found to be a major force in driving a networking project from its early, experimental, stages to a school or district-wide implementation.
- Integration of administrative data services into the overall network plan was found to be a particular benefit to the development of the network infrastructure. Many of the studied districts had MIS or administrative data processing departments which proved instrumental in the planning and implementation of network infrastructure. Further, since many district network efforts focus in their early stages on traditional information technology issues such as electronic record keeping and network design, district MIS staff can be quite helpful to educational technology planners.
- Community involvement was a critical factor in the development and on-going operation of a school or district network. Community support in many cases starts well before the actual planning effort for the network.

A supportive and involved school community is often one which fosters and supports educational change and innovation. As we have seen above, such environments are also those in which educational technology is well placed. Once the district begins technology planning in earnest, community and broad-based stakeholder involvement is critical to developing the technology plan and building the partnerships which will ultimately fund the plan. Over time, community support—generated through a strong informational effort on the part of the school or district—becomes the key for sustaining the funding for the network.

- In terms of infrastructure, the ModelNets researchers found that there is no clear one-way or best way to network a school district, but what is clear is that the network implementation and development must be guided by a visionary and functional technology plan. There is no single technological solution or networking technology which works best as a vehicle for district-wide networking. The best way to network a district is the way that works best for that particular district given its technical resources, economic conditions, history, workforce, environment, and expectations. Given that there are a number of different infrastructure implementations, the question then becomes one of how extensible is a district's networking plan.
- Broadband networking is an evolving technology, and schools are in the midst of the evolutionary continuum. We found a wide range of technology in use. Most study sites were either implementing very new and often untested technology (e.g., ISDN) or were upgrading from an older technology to something newer (e.g., 56K copper to fiber). Many schools were struggling to

afford sufficiently powerful workstations to attach to increasingly high-bandwidth networks (e.g., Apple IIs can't do much with Ethernet).

Finally, teacher training lagged well behind the technology available to most users. Technology, training, and policies—financing—are all separately moving pieces of the overall district networking effort. While a strong district technology plan may attempt to pull these pieces together—and in some cases does a pretty good job—districts across the nation face a challenging task; which to date, few have managed to overcome.

Focus
Technology Audit External Review of Plans and Uses

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As school districts plan to spend more time and money on technology, questions are emerging about its use. There is a need to reflect on what has been done before embarking on another major technology effort. This is particularly the case if the district is planning to ask it constituents to support a referendum to fund technology. In planning for such initiatives, a technology audit can provide the rationale and framework for dealing with technology-related issues.

The purpose of a technology audit is to compare school districts plans and expectations for technology with actual deployment and use. The audit facilitates continuous improvement by providing an objective reflection of the school district's technology direction compared to observed activities, best practices in schools, and trends in information systems and technology.

TIES, a technology consortium of 45 Minnesota school districts, has developed a framework and conducted technology audits in a number of school districts. The following areas are addressed:

- Information Systems
- Operational Environment
- Administrative Application Systems (Student, Finance, Human Resources)
- Technology Infrastructure (Telecommunications/Networks)
- Office Automation/Productivity Tools
- Teaching and Learning Applications
- Staff Development
- Technical Support

Each area is reviewed in the context of the following questions:

1. To what degree are work activities consistent with planned directions and expected outcomes?
2. How are technology resources, programs and staff managed?
3. In what ways is the use of technology measured so that there is a continuous improvement of processes and systems?

Panel
Technology Milestones for K–12 Education: Building Standards for All Students

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Key Words: **accreditation, standards, technology, K–12, education**

Summary

Goals 2000 sets the nation upon a course of school improvement through a process which focuses on high standards for student performances and development of local, state, and national plans for their achievement. Technology has been specifically identified as an area which must be addressed in these school improvement plans. This session will focus on a planning project funded by NASA to develop technology competency standards for K–12 students and establish specific applications of technology throughout the curriculum. The project's goal is to enable, through coordination and technical expertise, major stakeholders in K–12 education to develop national standards for the educational uses of technology that will facilitate school improvement in America.

This planning project used a standards development process derived from the experiences of NCTM and ISTE. Its focus has been on an iterative, collaborative process governed by key stakeholders, and others responsible for funding and implementing the resulting standards. The planning process has involved a hearing to concerned parties and included consensus-building activities on standards that are developed through the project. As an initial part of the planning project, a survey was developed to identify and sequence the technology skills and knowledge essential to support learning and effective use of information and communications resources.

A panel of ISTE Accreditation and Professional Standards Project members will provide a brief overview of the planning project and discuss the progress towards meeting the targeted goals. The survey will be distributed and discussed with session participants. Feedback will be solicited from the audience that will be used as part of the data for the project. The panel will conclude with a presentation of future directions for the standards project and plans for final development and dissemination of the technology standards for K–12 schools.

Project
The Thread that Runs Through It: Stranding as a Model for Integrating Technology in a Pre-Service Program

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Key Words: **pre-service, stranding, integration, technology, telecommunications**

At the College of Education at the University of Illinois, for the past four years an interdepartmental team of faculty and research assistants has piloted a stranding approach to technology integration. Rather than presenting technology in a one semester required course in isolation, the College of Education initiative, Teaching Teleapprenticeships (TTA), has integrated technology into a number of sections of pre-service courses, including a full year of the YLP (Year Long Program), a special program for fifty elementary education student teachers.

Components of this stranding model include the use of Internet resources such as the Web, mail reflector lists, e-mail, listservs, and creation of a Learning Resource Server. Other aspects include workshops on teacher tools such as spreadsheets, data bases, electronic portfolios, newsletters, and integration of multimedia into the curriculum. Instrumental to the stranding model is the loan of PowerBooks with high speed modems to the student teachers for the entire year. The student teachers use the PowerBooks for course work and personal productivity in the College, at home, and within their student teaching classrooms. Ongoing technical support includes an office staffed with research assistants available for face to face and continuous online help.

The technology profile of the TTA project has evolved over the four years of the project. The original idealization of the TTA concept could not have foreseen the specific developments in multimedia and Internet technologies since 1991. Yet, the project was designed to be flexible in these areas so hardware was acquired incrementally as needs and specifications changed. Many factors effected the selection and use of computing technology.

In addition to technological changes since the project's inception, modification of topics covered and actual teaching methods have reflected student requests and comments on biannual evaluations. In this session, presenters will display a timeline outlining the growth of the TTA project, documenting changes in hardware acquisition, topics, and teaching techniques.

Finally, presenters will share some of the lessons learned from this project, which include the benefits of small group work, the importance of strong technical support, the emphasis on hands-on learning, the use of real classroom teachers as technology role models, the opportunity to select from a menu of technology topics, and the contextualization of assignments and topics into authentic learning experiences.

The Teaching Teleapprenticeship project has been supported by the National Science Foundation, Apple Computer, and the Microsoft Corporation. The staff involved have documented impact, costs, and student feedback as they work to institutionalize this model on a larger scale.

Panel
High Tech Evaluation

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Key Words: evaluation, technology, media, video

Evaluation of complex and diverse technology initiatives presents a real challenge to educators. Assessing the impact of a grant or project can be facilitated through the use of advanced technology to collect, analyze, and present data.

The Microsoft Partnership in Illinois has involved annual donations of several hundred thousand dollars worth of software targeting teacher training and integration of technology into the curriculum. The evaluation of the Partnership has entailed collecting data statewide from multiple training sites which include materials, artifacts, video, and digitized images accumulated over a one year period. The group of panelists compiled such an evaluation during the 1994–95 school year, in which over 1,500 teachers received training, and donated software was used in classes by over 4,500 students.

The panel will present the evaluation model used for this project. The team of three panelists includes the grant administrator, a researcher with a background in statistics and evaluation who collected and analyzed data, and a researcher who specialized in networked media and multimedia.

The session will include discussion of the overall evaluation plan, with suggestions on how to organize a large scale evaluation. This will include discussion of budget, personnel involved, materials, equipment, and a timeline that this group followed for the specific evaluation used for illustration.

One focus will be on the data collection methodology, which required data collection across numerous sites. The data collection and subsequent analysis were driven by three factors: a) the audience, b) the purpose of the evaluation, and c) the kinds of information needed. The structured protocol required collection of data over the course of one year. Both quantitative and qualitative data were collected, and the results were aggregated across all sites for the final report. Samples of teacher created materials along with student projects and papers were included in the evaluation report.

A second emphasis is on the use of multiple media in the data collection process. This will include discussion of whether or not to include multiple media, what are the equipment and software needs for using various media, what issues are involved with obtaining consent to use pictures and video footage, and some additional factors to consider when thinking about integrating such media into an evaluation. The presenter will discuss online editing of the video footage and integrating the digital video and digitized images into slide presentation software such as *PowerPoint*. Finally, a list of all equipment, cards, and software will be included.

The team used a variety of advanced technology tools to complete the evaluation including telecommunications, fax, digitized images and video, and a variety of software packages for quantitative analysis. The tools will be discussed along with requisite equipment, such as a QuickTake camera and access to a color printer or photocopy machine.

Finally, the panel will present a number of recommendations based on their experience with this evaluation, including the importance of a full year plan, the need for a site contact at each location, the importance of setting up tables and data collection tools at the beginning of the year to assure uniform collection, the need to share expectations early and insure commitment from all participants, and the need to establish a budget to anticipate all expenses including staff, travel for site visits if necessary, equipment, mailing and photocopying costs.

The team will show samples from the final evaluation and demonstrate the tools used to complete it.

Project

Examining the Strengths and Weaknesses of an Online Discussion Group Experience

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Key Words: online discussion, teacher training, distance education, whole language

This presentation will describe the results of two studies that examined student reactions to participation in an electronic discussion group. The first experience took place in a college level "Distance Education" class. A listserv entitled Disted was established, and it was used as a means of exchange over the course of a semester. The experience was initiated with the instructor's request that students begin suggesting appropriate topics for discussion online throughout the semester. When a consensus was reached regarding a set of three discussion topics, students were asked to express their reactions to issues associated with each topic, over a period of several weeks. The second experience took place in a college course on developmental approaches to teaching reading to deaf students. Each student was asked to keep an "electronic journal" to which the instructor responded on a weekly basis. Journals were used as an opportunity for the students to experience a whole-language approach in their interactions with the instructor. The instructor's responses were designed to "mentor" her students, just as they might eventually "mentor" deaf children through journal exchanges. Journal entries were open-ended, with students generating the topics and controlling the length and style of the interactions.

Participation in both of these electronic discussions was required for class. Students were asked to write a paper that described their reactions to the experience. They also completed questionnaires which addressed the online experience. Survey results will be reported, along with anecdotal data based upon the student reaction papers, comments online, classroom discussion and face-to-face exchanges on an individual level.

A number of issues have been identified in the research literature as particularly significant to asynchronous online communication. Questions on the aforementioned survey will be based upon these issues. The three general areas of investigation will be into the effects of asynchronicity, invisibility, and form of articulation. In addition to these areas, the second experience examined change in students' perceptions regarding their use of e-mail and their response to communicating with the instructor in this manner.

The asynchronic nature of the experience allowed participants to react when they were ready, rather than immediately (as would be the case in face-to-face interactions). This allowed them to respond at their own convenience, which helped foster positive attitudes about the experience. This delay also provided time for them to think more carefully about their response, perhaps contributing to more reflective responses. But delays may also have robbed these discussions of their spontaneity. Especially when several different discussions were going on at once, delays could make a discussion disjointed. It sometimes became difficult for participants to remember exactly what comment a given contribution is reacting to, if that comment occurred several days (or even weeks) earlier. In electronic discussions, people also went off on tangents more easily than in face-to-face encounters, where there is some social pressure to address yourself directly to your fellow students.

Interactions on such a system have an "invisible" characteristic, in that the participants do not see each other. This lack of visual cues can make it more difficult to determine how people are reacting to a particular comment. Normally we gauge this by attending nonverbal cues, such a posture, facial expression, etc. Some were uncomfortable not having this information. Without sensing some encouraging non-verbals, some appeared less inclined to participate. On the other hand this non-verbal communication, when it is negative, can also be an inhibiting factor in discussion. Without it, some participants seemed to feel more capable of saying what they really thought, regardless of how others might react. The "invisibility" of the experience also appeared to help those who might be shy in group situations. Typing on a keyboard and reading a monitor can be less threatening to some than speaking out, in front of a large group of people.

Finally, the fact that online comments demand that people write, rather than speak, has its own set of implications. This will affect individuals differently, in that some like to write but others do not. Some write well but others do not. However, it appears to encourage more articulate responses, in general. For when participants have an opportunity to rethink and revise their remarks in writing, the results are generally more polished than spontaneous spoken expressions would be. Also, the group appreciated having a written record of remarks to which they could refer, as the discussion evolved. This written record was also advantageous to the instructor, for purposes of evaluation.

In the electronic journal experience, the extensive conversational control given to the students provided a unique learning opportunity, in a facilitative way, rather than in a directive one. The availability of this technology makes this approach feasible on an ongoing basis throughout the week, rather than on an episodic basis. The technology facilitates whole language experiences, so that students can learn these techniques by doing, as well as reading or hearing about them.

After describing the results of this study, the presenters will solicit comments from the audience regarding their experiences with online discussions. Specific kinds of circumstances that may affect the nature of the ensuing discussion will be explored.

Project

Meeting the Challenges of Computerized Multimedia Production

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Key Words: **computer, multimedia, authoring languages, digital television, CD-ROM, historical documentary**

This presentation will describe the process involved in developing a series of digitized interactive multimedia packages, based upon footage from a television program. It will describe the challenges faced in doing so, the solutions which were used to overcome those challenges, and the "lessons to be learned" for producers of computerized multimedia packages.

This project began with the production of the one hour television documentary about the shootings that occurred on the Kent State University campus twenty-five years ago. This program included a great deal of archival visual footage, music from the time period, and interviews with ten eyewitnesses who were there that day. To make this material more widely available, the production was digitized for use on several other formats: a CD-ROM, a campus kiosk system run off a large hard drive, and the university's home page on the World Wide Web. These formats also allowed for user interactivity with the material, so this was programmed in, using an authoring system. Samples of the program on CD-ROM will be played for the audience.

To import, digitize, and edit the various clips of audio, still frame, and video, the popular software package Premier was used. There were several significant challenges associated with this effort to convert video footage to an interactive digital format. These difficulties are ones that many multimedia producers face. One was the issue of space. Fifty-three minutes of television takes up so much bandwidth that it cannot be placed on any of these formats, without some severe compression. Consequently, it seemed necessary to edit out some of this material. In addition, some tricks were used to save space. For example, rather than use the full video, interview material, audio was provided along with a still frame picture of the person. This approach used far less space than full frame television footage would have. Issues such as compression rates, viewing size in pixels, number of video frames per second, audio quality in hertz, and other somewhat "technical" matters will be described. Their impact on the final look of the program will be discussed and, where possible, demonstrated.

The next challenge was to find an authoring system that would be able to create an effective, interactive program, using this material, and that would do so on both Macintosh and IBM platforms. Authorware, a multi-platform product, was selected. Its icon-based commands make it relatively user-friendly. This system allowed for creation of "shells" that called up the material from the original television program and allowed for user interaction with it. A brief look at the iconography and logic structure of Authorware will give the audience some sense of how it functions.

Finally, the steps associated with transferring the final program to each of the three formats will be described. The CD-ROM was pressed with a machine recently purchased by the presenter's institution. HyperText Markup Language (HTML) was used to place it on the university web site.

The presenter will conclude with his recommendations for dealing effectively with a project of this kind. He will then solicit remarks from the members of the audience regarding experiences they have had, so that other suggestions about how to approach multimedia production can be heard.

Project

Breaking the Stereotype that CS is Just for Male "Geeks"

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Key Words: **women, female, stereotype, non-major, multimedia, computer science**

The creation of an inviting, nurturing environment for women in the discipline of Computer Science (CS) has been a difficult problem. The scarcity of women in undergraduate CS programs nationwide has concerned and befuddled academicians and employers alike in the last decade. Although statistics demonstrate equivalent or superior performance in computing-related courses in high school, women are far less likely than their male counterparts to pursue further courses in computing at the undergraduate level, continue on to earn a Ph.D. in CS, or take academic or industrial positions in computing. This phenomenon—referred to as the "pipeline effect"—has received considerable attention in the Computer Science literature. Explanations include a comparative lack of self-esteem due to subtle prejudice and disrespect from instructors and colleagues, the scarcity of female role models, and the predominant view of CS as the domain of socially maladjusted males, ("geeks," if you will).

The objective of this project has been to create a more inviting, supporting environment for women in computing by demonstrating the particular relevance computing has to women, and by challenging the stereotype of Computer Science as being of interest to males only. We have sought to accomplish this objective by integrating new material into our introductory computing course at Furman. It is expected that changes in this course will naturally extend throughout the curriculum as well.

The re-designed course consists of six interleaved components—history of computing, computing applications, problem solving, current research, ethics and the future of computing—using multimedia computing as the central organizing theme. We have incorporated gender issues with each of these components in different ways. In addition, we have studied the issue of how pedagogical strategies can have a positive or negative impact on the perceptions of women students. The literature pertaining to women in science has strongly guided and motivated this project.

Though the accomplishments of males are more lauded and thus better remembered, the contributions of women to the development of computing as a discipline have been considerable. Such contributions are discussed in the class alongside those of the notable men.

Certain applications of computing can be viewed as having particular relevance to women. One example is the Human Genome Project, a compute-intensive project with profound implications to human fertility and reproductive choices. Another is the Internet computer network. In general, telecomputing—and hence "telecommuting"—are having a dramatic impact on the structure of the family and the traditional male/female roles within that structure. These and other applications of computing have been sought out, and are being discussed and utilized in the course. Additional applications without specific gender relevance have also been emphasized in order to stress the clear practical, "real life" uses of computing to both women and men.

Women are major contributors to current research in computer science. Students, both male and female, should be aware of that fact. We have identified interesting examples of such research for use in class discussion of the "cutting edge" of the field. In this instance, specific researchers are mentioned by name, with an even balance between women and men selected. The objective is to demonstrate the significant role that women, as well as men, are playing in modern Computer Science.

The problem solving component of the class incorporates gender by utilizing examples and assignments which have specific relevance to women, or simply have a very practical application. In previous iterations of the course, examples and problems were of the "toy" variety, demonstrating the capabilities of various tools, but were not likely to be re-used after the class. This is an attempt to incorporate research which suggests that women are more interested in the utility and social impact of computing than in isolated examples of "cool" things computers can do.

This research is also the motivating force behind the discussion of ethical issues. Widely incorporated into CS curricula in recent years, a significant, discussion-based ethics component has been included. Additional discussion (in conjunction with a writing requirement) has centered around the future of computing, together with societal implications. Nicholas Negroponte's *Being Digital* is the basis of the discussion.

With only one iteration of the course completed, there is more refinement to be done. However, anecdotal evidence suggests that the approach has been successful in addressing its objectives.

Project
The Effect of Multimedia Training on Creativity

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Key Words: **multimedia, HyperCard, creativity**

This presentation will present both qualitative and quantitative data collected from a study conducted during the Spring semester of 1993 at the University of Southwestern Louisiana on the impact of multimedia training on student creativity. The instruments used in this study were the Torrance Tests of Creative Thinking (TTCT) figural streamlined, Forms A and B. A pre- and post-test of the TTCT were given to the participating students at the beginning and the end of this study. This study also pilot-tested the use of the computer as a vehicle for administering the TTCT. By administering the TTCT on computer as well as by traditional means, comparison was made between the two testing formats. Students involved in the project were required to journal following each multimedia training session. In addition to the quantitative data collected from the TTCT, qualitative data such as students' journal and their art work on computer was carefully examined by this study as well. The qualitative data collected by this study confirmed the rich learning environment provided by the use of *HyperCard* and multimedia. Some encouraging evidence was collected by this study in support of using the computer as a tool for expressing and measuring creativity.

Project
Growing Gardens, Growing Ideas—Interdisciplinary, Technology-Based Learning

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Key Words: **garden, science, interdisciplinary, elementary**

The Enfield Elementary K–5 school (Ithaca, NY) started with a science, garden, and technology project in one grade and then enlarged it to another grades. Soon other grades decided to have their own garden and garden projects. The school went on to obtain a Microsoft *Road Ahead* grant. All teachers went through workshops which focused on using technology to further the students' science learning in gardens. The school involved the local nature center to help provide additional support. The classes use many different technologies to document what the students learn from their garden—digital cameras, scanners, multimedia, etc. They use the garden as a source for writing, reading, math, graphs, science, Social Studies, and many interdisciplinary activities and they use technology to demonstrate their learning. You see numerous student projects about their garden learning.

Focus
Using Technology to Ease Students' Racial and Cultural Tensions

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Key Words: **race, culture, interdisciplinary, technology, multicultural**

Some elementary teachers in the Ithaca City School District, Ithaca, NY realized that they could start the peace-making process at the elementary level to reduce tensions in the high school where students often have conflicts due to their different racial and cultural backgrounds. The teachers decided to create various technology based projects to help students to learn about one another and to work together on common problems. These projects let students share their similarities, enjoy their differences, see each other as real people and see each other as people with similar interests. The students do feel differently about the students in other elementaries now. They realize that many of their stereotypes about each other are not true. Several of their simple-yet-humanly-powerful technology-based projects will be shown.

Society
Internet Issues for Directors of Technology (SIGTC)

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Key Words: **Internet, planning, policies, technology directors**

More and more schools, school districts, colleges, and universities are providing direct and dial-in connection to the Internet for their students and staff. As access becomes available for students and staff many questions will arise that are procedural, but others will ultimately result as policy level decisions. The new Federal Telecommunications Act will have significant impact on how, why and under what conditions access is to be afforded. Learning communities will need to plan for this resource systematically and systematically so it can be a blessing not a curse.

Issues of technical capacity planning that impact the infrastructure as well as the computers and file servers attached tend to occupy much of the planning time, but they are only a piece of the picture. Understanding the acceptable use policy that is part of the contract with an Internet provider and determining whether you need to augment it for your community is a critical step in the planning. Resource needs with regard to additional staffing, technological resources, acquiring IP addresses, e-mail addresses, domain name service, establishing your own web server, firewalls, funding, staff development, and instructional design are just the tip of the iceberg.

This society session takes a look at these issues and more in a way that sets the stage for a successful, if not worry-free, experience.

Project
Atmospheric Explorations: Interactive Exhibits in Meteorology

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Key Words: **meteorology, exhibit, interactive, microcomputer**

Project Summary

Atmospheric Explorations is a three-year project funded by the National Science Foundation and designed to produce three museum exhibits that allow museum visitors to interact with the physical principles underlying atmospheric behavior. The exhibits are microcomputer-based programs that model physical systems and display the results of visitors' interactions in highly graphical, animated form. A panel of junior-high teachers are assisting in the development of materials to enhance the use of these exhibits by visiting school groups.

Project Goal

The goal of the project is to enable visitors to explore weather interactively in a way that is both faithful to the physics involved and entertaining. This goal was chosen because many important concepts in the physical sciences are difficult to learn through conventional methods.

An example of this is the cause of seasons on Earth. Microcomputers can now perform the calculations needed to model seasons over the entire Earth's surface and display the results in only seconds. This capability allows visitors to manipulate the Earth-Sun system to explore the mechanics of seasons; they can see the results of the changes immediately. This type of interaction with a modeled physical system has proven to be instructive and popular with visitors.

Project Development

The project team includes meteorologists from Augsburg College and exhibit developers from the Science Museum of Minnesota. Microcomputer programming was performed at Augsburg. The Science Museum developed auxiliary interactive exhibits that helped visitors further explore key concepts.

Development began by determining a set of appropriate potential exhibit topics, the entry levels appropriate for museum visitors, and the meteorological general interest areas of visitors. Because the target group of museum visitors for these exhibits was made up of seventh- and eighth-grade students, focus groups were made up of elementary-school students and teachers.

Focus groups guided the selection of three topics. The first of these, *Seasons*, was developed into a working prototype and improved through an iterative process. Museum visitors were invited to use the exhibit in "think aloud" mode; their interactions were used to suggest changes in the exhibit. The prototype was revised and returned to the museum floor for further evaluation. This process was repeated until the team saw that the exhibit had reached a high level of maturity.

Further studies of visitors then measured the duration of their use of the exhibit and the complexity of their interactions. Questionnaires were used to gather visitors' opinions of the exhibit.

As *Seasons* was moving through its formative evaluation, a second exhibit, *Winds*, was prepared. Lessons learned from *Seasons* were applied to *Winds*, which helped to reduce the time required for its evaluation. A third exhibit, *Clouds*, has now moved to the prototype phase and is undergoing evaluation.

Exhibit Descriptions

Seasons

Many people have serious misconceptions about the cause of the Earth's seasons: many believe that it is the distance from the Sun to the Earth. *Seasons* invites visitors to change the tilt of the Earth's axis (the real cause of seasons) and the shape of the its orbit. They then start the computer model which shows them how the seasons progress as a result. The visual display shows them the temperature over the entire Earth's surface as it is shown orbiting the Sun, and also charts the temperature at latitudes of their choosing.

Winds

The reasons that there is wind and why the wind blows from a particular direction is obscure to many people. *Winds* illustrates the winds that result from pressure centers (highs and lows) on a continental-scale map. Visitors can move highs and lows about on the map and see the pressure and wind fields change in response. They can also change which hemisphere they are in, stop the Earth's rotation about its axis, and change the friction between the atmosphere and the surface. A very popular feature allows the visitor to drop a weather balloon on the map and watch the trace of its path as the wind moves it.

Clouds

Summertime cumulus clouds are common, but the reason they form is another difficult concept. *Clouds* allows the user to change the temperature and moisture content of the atmosphere at several heights and see what happens during the course of a summer day. They learn the reason that there may be no clouds, simple cumulus clouds, or thunderstorms that develop.

Conclusion

The two exhibits that have progressed to their mature stages, *Seasons* and *Winds*, have proven to be very popular with museum visitors. Their subject matter, interactive nature and the immediacy and stimulating quality of their graphic presentations are largely responsible for this. The ability of museum visitors to interact meaningfully with these complex exhibits suggests that exhibits such as these may be useful in illustrating a wide variety of physical processes.

Focus
Electronic Portfolios—A Plan in Place for Grades K–12

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Key Words: **K–12, portfolios, electronic portfolios, HyperCard, CD-ROM, portfolio assessment**

Imagine graduating from high school. As you walk out the door, nostalgia and anticipation mix, leaving you insecure about your future. But as you reach in the pocket of your gown, your fingers touch CD containing your science experiments, your writing samples, and your analysis of a novel presented with film clips, graphic arts, and even a segment of symphonic music you composed. These remind you that through hard work and technology, you opened doors previously closed to you. Your future seems wide open.

Through the Electronic Portfolio program, North Central High School is creating an electronic media record for graduates of a special pilot program. Yet, while students wait for graduation, they don't have to wait for technology. All schools within Washington Township are teaching students how to use word processing, desktop publishing, and hypermedia to make their classes much more fun, creative and educational.

Because the district had a strong language arts portfolio program and record of participation in state writing programs, the Department of Education of Indiana asked the district to explore electronic portfolio assessment.

Thanks to that request, teachers, students and parents at Allisonville Elementary School, Westlane Middle School and North Central High School can now review and better assess a student's progress in English and language arts. With technology, much of a student's work becomes concrete. For example the writing process can be tracked, use of detail observed, and spelling ability monitored.

The program also allows for creativity, as students interact with their writing. students analyze poetry, develop interactive presentations on values, and capture final year-end projects using multimedia tools available on the computer. In this way, each student has the opportunity to individualize learning. Greater creativity from each student becomes very evident within the teacher's framework.

A natural benefit occurs when students apply the technology skills to other areas. Students visit the computer labs before, during, and after school to use the technology for science experiments, social studies, math, and music projects as well as the language arts assignments.

To support learning through technology, the district's teachers are learning to become more flexible and play the role of a coach instead of a lecturer. Their technology training is provided before, during, and after school, many times in the Electronic Portfolio classes along side their students in their classrooms. The success of creating multimedia projects instead of pencil and paper projects is most evident in the high interest rate generated in our students.

At the high school level, most students' paper and pencil projects can't be finished soon enough and handed in for grading. It is most noticeable that once a student begins a multimedia project, he/she never considers it finished and will add to it until the final bell rings! Many students are so proud of their presentations, they have even returned long after the grading was completed in the classroom to make improvements for their own personal satisfaction. Just presenting students with the opportunity to store their previous projects and any others they create electronically into their electronic portfolios makes it all worth it for the student.

Electronic Portfolios was a 1994 GTE Pioneering Partners Award Winner. Business partners who assisted in the development were Sony Electronics, Apple Computer, and the Indiana Department of Education along with GTE.

Focus

Teaching, Learning, Technology: Palau, a Pacific Nation, Doing Different Things!

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Key Words: **Palau, teaching, learning, technology, professional development, curriculum integration**

The Republic of Palau, a new Pacific Nation, consists of 2,000 islands, 16 states, and 80 hamlets covering 181 square miles; the population is 15,000. There are 2,598 students in grades one through eight and 951 students in grades nine through twelve. Palau has 23 elementary schools and 6 high schools. These schools have approximately 150 computers that are part of multimedia setups including laser and color inkjet printers, videodisc players, VCRs, scanners, and digital and video cameras.

In 1992 Palau embarked on a **Teaching, Learning, Technology Project** designed not only to bring technology to the students and teachers but to bring *new strategies* for teaching and learning. The project uses a curriculum integration model that encourages student-to-student and student-to-teacher interactions; a model where the mimetic approach to education gives way to a constructivist approach to education. Teachers and students use various innovative optical technologies (computers, videos, and videodiscs) to complete multimedia projects in various grade levels and curriculum areas.

The professional development series changes the way teachers teach and students learn, leading ultimately to improved student achievement. The model developed by Rayburn (1992) and revised and implemented by Wahl (1992–1995) is used by the Palau Ministry of Education for professional development activities. This process helps teachers improve skills, attitudes, understandings, and performance through a series of courses which are approved for university credit. Approximately 100 educators (in groups remaining constant over an extended period of time) participated in five to six courses—150 hours.

A practical hands-on approach along with technical support helps teachers acquire technology and instructional skills in a cooperative learning setting. Independent study plans, an integral part of each course, give teachers opportunities to apply new skills, change their behavior, and modify ideas with their students. The activities help teachers create educational environments in which teachers and students are encouraged to **explore, think, rethink, demonstrate, and exhibit.**

A cooperative learning model is used in the professional development series for two reasons. First, research evidence supports the idea cooperative models are very effective in today's classrooms; the courses model a strategy teachers are expected to use. Secondly, the model encourages "moral support." Many of the teachers involved require a strong underlying support group to help them overcome the "fear" and "frustration" associated with technology.

Envision a set of stairs with each step representing an opportunity to learn new skills and strategies, a chance to practice what was learned on the previous step, and a requirement to use it with students in the classroom. The five stages of technology application used to indicate individual stages of proficiency is an outgrowth of the Apple Classrooms of Tomorrow (ACOT) research studies—entry, adoption, adaptation, appropriation, and invention. The educator acquires and practices new technology/instructional skills, uses the skills with students, and networks with a team of teachers at each stage. By the year 2000, most Palauan teachers will be at the Invention Stage using technology as a tool to enhance, enrich, extend, or transform curriculum (Dyril and Kinnaman, 1995) to meet the needs of Palauan students living in the twenty-first century.

Making innovative optical technologies accessible to teachers and learners is not just about technology; it is about a better way to communicate ideas, a better way to investigate, and a natural way to learn and interact. This approach engages both the mind and the imagination, promotes student-to-student interaction and changes students (and teachers) from passive content memorizers to lifelong active and technologically literate learners. It is about changing the model of a teacher standing in front of a room dispensing information (the way teachers were taught) to a model where teachers take advantage of technology as a tool to help teachers and learners think and explore. It is about doing different things versus doing things differently (Thornburg, 1994).

No longer is it enough just to read and write. In a world where information comes in many forms—text, audio, graphics, video—and where the amount of information is increasing at exponentially staggering rates, the literacy skills of the last 20 centuries will not take our students into the 21st century. Clearly, we must move our definition of literacy beyond the three R's to the four C's—Communicate, Compute, Collaborate, and Connect.

Paper

PipeLINK: Connecting Women and Girls in the Computer Science Pipeline

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Abstract

The PipeLINK program seeks to attract and retain women and girls into careers in computer science. Aimed at girls and women from the high school through the Ph.D. level, the program provides activities to aid participants at each level, find role models and mentors from the levels above, as well as an introduction to a wide variety of computer science topics. This paper describes PipeLINK activities that were carried out during the academic year 1994–95 and the summer of 1995, including an evaluation of their effectiveness.

1. Introduction

A common theme in discussions about the underrepresentation of women in science these days is the "pipeline" metaphor; women enter the pipeline to a scientific career in high school, but the pipeline narrows (i.e. a higher percentage of women drop out) as the level of study increases. This effect is extremely clear in computer science, where high school girls and boys show interest in computer science in nearly equal numbers, but only a very small percentage of the full professors in the field of computer science are women. One goal of PipeLINK[*] is to attract more girls at the high school level to the study of computer science, by making sure they are aware of the field and its opportunities. A second goal is to retain women in the pipeline; i.e. to increase the number of females at each educational level from high school through the Ph.D. who continue in the study of computer science.

The PipeLINK program addresses retention by creating a women's network, connecting several levels of the pipeline (high school students, undergraduate students, graduate students, as well as women faculty) so that women at each level see role models at the higher levels, and additionally so that women at each level will themselves be role models and mentors to women at the earlier levels. With these connections, not only do women benefit from role models and informal mentoring from more senior women, but they also reap the rewards of being role models themselves. To encourage these connections, we created an electronic mail network for girls at the high school, with participation by undergraduate, graduate, and faculty women interested in computer science. Face-to-face contact was also encouraged via a number of on-site activities. We sponsored talks and visits by senior women faculty to Rensselaer and by Rensselaer faculty and students to high schools. High school students were invited to attend activity days at Rensselaer. Finally, we included high school, undergraduate, and graduate women in a summer program of research and enrichment in computer science.

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Many women in computer science are choosing not to get an advanced degree. Articles discussing women in computing point out that there is a "pipeline shrinkage" as women move through the pipeline from high school, to an undergraduate degree, to a Ph.D. [3, 6, 5] A 1990 National Science Foundation survey showed that approximately 50% of students in high school computer science courses were women [4]. Using longitudinal statistics available from the computing research association [2], we can follow a hypothetical "class" of computer scientists: in 1985, the percentage of women among B.S./B.A. recipients in CS was 37%, in 1989, the percentage of women among M.S. recipients was only 28%, and among Ph.D. Recipients in 1991, the percentage of women was only 15%.

The most recent (1994) statistics at the university level show that the number of women is consistently low: 18% for B.S./B.A. degrees, 19% for M.S. degrees, and 16% for Ph.D. degrees in computer science and engineering [5]. Further along the educational pipeline, the number of women in computer science drops precipitously: 18% of assistant professors are women, but only 9% of associate professors and 5% of full professors of computer science or computer engineering are women. Two issues cited for this "pipeline shrinkage" are lack of role models and lack of self-esteem among women [1, 9, 8].

In this paper, we describe our PipeLINK program, including activities that introduce technical areas of computer science to the participants while concurrently connecting them with older female role models. Section 2 of the paper describes the participants in the program, then Sections 3 and 4 describe the academic-year and summer activities, respectively. Finally, Section 5 presents an evaluation of our program, including both immediate feedback and end-of-year feedback (for the academic-year portion of the program).

2. Participants

The participants in our program were undergraduate and graduate students, university faculty, high school students, and high school teachers. The majority of the university participants were in the area of computer science and from Rensselaer. The 16 participating high schools were a mix of public and private schools in the Albany-Troy, New York, area—all close to Rensselaer. The high school teacher contacts at the schools were mostly from the areas of advanced mathematics or computer science. The majority of participating students, faculty and invited speakers, and many of the high school teachers were female.

During the academic year, activities were open to all potential participants on a first-come, first-serve basis, until no more space was available. Overall, participants included approximately 60 high school girls who visited Rensselaer, approximately 1,000 high school students (boys and girls) who attended talks at their high schools, 15 undergraduate computer science majors, and ten graduate computer science majors.

Although the last two numbers look small, they represent 42% of the female undergraduate computer science majors and 47% of the female graduate computer science majors at Rensselaer. In addition, we had one or two primary contact teachers at each participating high school who came to training workshops that we held, and many of whom participated in activities with their girls. Although parents were not targeted, several parents attended one of our activity days at Rensselaer, and many parents participated in the summer program by attending at least one of the two scheduled visitor's days.

For the summer programs, eight undergraduate students from throughout the United States, and 20 high school students from our participating high schools were chosen. The undergraduates were chosen from over 40 applicants on the basis of their scholastic excellence, mentoring experience, enthusiasm for the program, and preparation to carry out undergraduate research. The high school students were nominated by their teachers (each teacher was asked to nominate a primary candidate and an alternate, and we took as many alternates as we could). Of the 16 participating schools 14 were represented in the summer program. Additionally, two Rensselaer women graduate students were hired to be TA's and to develop materials and activities for both summer programs.

3. PipeLINK Academic Year Activities

During the academic year, activities consisted of 16 high school visits, three high school teacher workshops, two high school activity days at Rensselaer, monthly undergraduate and graduate lunch meetings, and participation in an electronic mentoring network, consisting of bulletin boards, chat groups, and e-mail. Each high school was visited by a female professor and a female student of computer science, who made presentations highlighting interesting applications of computer science.

These presentations consisted of several different modules of approximately ten minutes long, including one developed by the student. Topics covered in presentations included robotics, graphics, computer vision, algorithms, computational complexity, the Internet, and the history of computing. Most graduate students presented modules about their research area, and most undergraduate students prepared modules describing what they had learned in a favorite course. The high school students reacted very positively to the university student presentations, often spending time after the session discussing issues informally with the university students.

The high school teacher workshops were held at the beginning, middle, and end of the academic year. At the first workshop, we presented the program's goals and brainstormed about activities that would attract girls' interests. At the second, we evaluated the high school visits, and trained teachers on the electronic mentoring system (this system did not come online until January). The third workshop was held primarily for program evaluation.

The high school activity days were a highlight of the academic year portion of the PipeLINK program. Each session had two activities: Internet surfing and either simulating mathematical models of "Growing Plants and Trees" or practice with the PipeLINK electronic network. In addition to the faculty leaders, each activity day session had two to four female Rensselaer student helpers, who walked around the room and assisted students who had some difficulty. These helpers and session leaders had a chance to get to know some of the girls individually.

The electronic mentoring network provided e-mail, chat, and bulletin board services for the high school students, high school faculty, and undergraduate and graduate computer science students at Rensselaer. After the second activity day, we added Internet access to the system, because of demand from the students and teachers. We had some technical difficulties which delayed making the system available until January, but once the system became available, the girls began using it, especially for e-mail and the Internet.

The activities for undergraduate and graduate women computer science students at Rensselaer consisted primarily of monthly informal lunch meetings, where issues of interest to women were discussed. The first of these was a dinner meeting where the PipeLINK program was outlined. At subsequent meetings, issues discussed included the academic atmosphere for women in computer science at Rensselaer; the current job market, especially for women; tips on choosing courses, advisors, and thesis topics; and the variety of paths that we followed into computer science.

Another activity sponsored by the PipeLINK program for Rensselaer participants was the invitation of a distinguished woman computer scientist to speak in Rensselaer's Computer Science Colloquium. Through the PipeLINK mailing list, women computer science students were invited to three additional computer science colloquia presented by women in the 1994–95 academic year, as well as a presentation to the ACM student chapter about some of the issues facing women in computer science.

4. PipeLINK Summer Activities

During the summer of 1995, two programs were held at Rensselaer: a ten-week undergraduate research program, and a two-week high school program. In the undergraduate program, eight women undergraduates from throughout the United States conducted research projects under the direction of women faculty or graduate students. These women also served as teaching assistants (and "counselors") for the high school program that was held during the last two weeks of the summer. In the high school program, 20 girls from 14 high schools experienced a wide variety of areas of computer science through laboratory activities, lectures by computer scientists from Rensselaer and other institutions, and visits to industry sites.

The eight undergraduate participants were matched with six mentors (two mentors took two students each). Since there is only one female computer science professor at Rensselaer, the mentors also included women faculty in mathematics and mechanical engineering, and female Ph.D. students (all three student mentors were in the final stage of the Ph.D. program) in computer science, and electrical and computer systems engineering. The undergraduate research topics included computer simulation of heat transfer, computer vision, computer supported collaboration [2], geometric algorithms, fuzzy logic, neural networks, and machine learning.

During the summer, all undergraduate participants met for weekly lunch discussions, with the leader rotated among the undergraduates. Topics discussed included topics of interest to women as well as computer scientists, including: "Women in Computer Science," "Net Censorship," "The Information Superhighway," "Co-ed vs. Single-sex Schools," "All About Grad School," and "What We Like about Computer Science." This last topic overlapped with the participants in the high school program.

At the end of the program, each undergraduate made a research presentation to the high school students and other undergraduates. The mentors helped the undergraduates prepare their talks, suggesting visual aids wherever possible. As a result, all the presentations were well prepared and captivated the high school students. The undergraduates' enthusiasm showed that they had found their research work interesting.

The high school program participants were nominated by their teachers. Most had completed their sophomore or junior year in high school, although many of them had no coursework in computer science. During the course of the program, the girls participated in 11 labs, including communicating via e-mail and chat, creating their own home pages on the World Wide Web, developing their own computer animations, creating guessing games using probabilistic reasoning, and learning to program in C++ [7]. Lab instructors were assisted by members of the undergraduate research program as TA's. The program also included nine lectures on areas as diverse as databases, computing languages, symbolic mathematics and robotics, and had three field trips, visiting laboratories on Rensselaer's campus, a local startup company, and a nearby international corporation's research laboratory. To increase the degree of informal contact between undergraduate and high school participants, undergraduates were scheduled to eat meals with the high school girls and to lead evening activities.

During the high school program, both the undergraduate and high school students met many female computer science role models. In addition to the female graduate students and professors at Rensselaer, the students met two female professors and one female Ph.D. student (in the final stage of her Ph.D.) from other Universities who gave interactive talks. In addition, the participants visited a local industrial site where seven women from different areas of the company gave a short talk on their work and how they got to this point in their career.

5. Evaluation

During the academic year, the evaluation of our program was conducted through questionnaires at the end of the year, in addition to the end of each workshop and activity day. During the summer, questionnaires were given at the end of each week for the high school program, and at the end of the summer for the undergraduate program.

The evaluation at the teacher's workshop included questions about the school visits. Twelve of fifteen teachers responding wrote that the students' overall reaction to the visit was positive or very positive. These evaluations also showed that one feature that was missing from the PipeLINK program was support for the teachers in learning to use the electronic mentoring network and the Internet. In future programs, we plan to assign an undergraduate helper to each high school to aid the teachers and students in using our system.

Over sixty girls attended the four half-day activity days held at Rensselaer. The evaluation questionnaires we handed out at the end of each activity were very positive. One student wrote about the first activity day, "I found today's activities to be very educational in a fun way. I really enjoyed the Internet hunt and trying to figure out the other questions that were submitted. It was fun and challenging, and I learned a lot about the Internet System." At the second activity day, we asked students whether it was their first or second time, and why they had come. 100% of the second-timers wrote that they returned because of their positive experiences at the first activity day. For example, one wrote "it was fun last time," and another wrote "because I enjoyed the first so much." At the end of the second activity day, more than half of the responses to the question "Do you have any other comments for us about today's activities?," mentioned that the activity was fun or enjoyable, for example, "I had a really great time, keep it up. I'll be back next year if this happens again!" Overall, 82% of the respondents to the year-end questionnaire wrote that they would attend future activity days if offered.

Responses to our academic year-end questionnaire indicated that the most popular aspects of the electronic mentoring network were e-mail and Internet (60% of respondents used each regularly). Fewer girls were using the electronic chat (41%) and bulletin boards (32%) on a regular basis. The year-end questionnaires showed that the PipeLINK program primarily achieved its goal of introducing high school girls to the opportunities in computer science. Approximately 75% of the girls who answered the question, "Did any part of the program affect your interest in computer science?" answered affirmatively. Many answers echoed the comment of one student, "I've learned more about computers and the Internet. I think the Internet is great because there is so much info for everyone. PipeLINK showed me about computer science and now I know what it is, how it's used, and in college, I plan to take computer science because it interests me greatly." One of the motivating factors for many of these girls was the use of computers for communication. In addition to many girls who mentioned the Internet, others referred to additional forms of communication, for example: "I was interested when I learned that you could contact & meet new people over the computer." The PipeLINK program was successful at the high school level both in attracting girls to computer science, and in breaking the stereotypes of how computers are used and who generally uses them.

Undergraduate and graduate students benefited from role models and from themselves being role models. One graduate student wrote, "I think that most of the activities were great, and that they went a long way toward addressing the problem at hand." An undergraduate wrote that one session "was very helpful on a personal level for understanding more about the role of women in computer related fields; very informative." After our Distinguished Professor's visit, many positive comments were made by both women and men about her talk. One woman graduate student wrote, "It is always encouraging to me when a woman computer scientist gives an interesting and well-presented talk about their research."

In the summer undergraduate research program, both mentors and mentees expressed satisfaction with their summer experiences. At least one undergraduate participant decided to pursue a Ph.D. based on her experience, and all but one are planning to apply to graduate school.

In the summer high school program, all the participants enjoyed themselves. At the end of the first week, one girl wrote, "This program is really good. It's great to get people interested and acquainted with computers. Some schools don't offer courses like this." Another wrote at the end of the second week, "Nice to meet women working and enjoying computer work." Finally, another girl neatly summed up our goal in the program, writing "This program helped me to see what careers are available in computers and what topics there are to explore." There is no question that for many girls in the summer program we achieved this goal.

When high school summer participants were asked to name their favorite activity, e-mail and the World Wide Web (or Internet) tied for the most popular. Over the two-week period, the average number of e-mail messages sent by participants was over 93! Five of the six most popular activities were laboratory activities, and the sixth was "making new friends." A typical comment at the end of the program was, "I had a really good time. I learned a lot and it was very interesting. I hope I will be able to come to the next one." Overall, a total of 83% of the girls wrote that they would come back if given the chance[6].

Conclusion

Most of the undergraduate and graduate students who participated in PipeLINK activities over the year are still Rensselaer students, so it is too early to determine whether PipeLINK is achieving its goal of retaining women in the computer science pipeline. However, anecdotal evidence is encouraging. Three PhD students chose to mentor undergraduates in the summer program, and they are considering teaching careers. One senior who graduated and took a job hopes to participate in future events as an industry contact. A Masters student is considering becoming certified as a high school computer science teacher. Each of these participants, in her own way, is planning to become a visible female role model for future computer scientists.

For the high school participants, the most interesting aspect of our program was the activity days and two-week summer program. The electronic mentoring system was popular for its e-mail aspect, but not as popular for its bulletin boards. We believe that was due to its late start in the program, and our small amount of physical contact with the high schools (only one visit per high school). We believe that increasing the contact with the high schools (a visit once every two weeks) will improve this part of our program.

References

[1] K. Arnold, Retaining High-achieving Women in Science and Engineering, AAAS Symposium on Women and Girls in Science and Technology, University of Michigan, July 1987.

[2] Computing Research Association, Statistical Trends in Computer Science, http://cra.org/stats/Trends.html (World Wide Web page).

[3] K. Frenkel, Women and Computing, Communications of the ACM, Vol. 33, No. 11, p. 34–46, November 1990.

[4] National Science Foundation, Women and Minorities in Science and Engineering, January, 1990.

[5] Mentor project passes muster, Computing Research News, Vol. 7, No. 4, September 1995.

[6] A. Pearl, M. E. Pollack, E. Riskin, B. Thomas, E. Wolf and A. Wu, Becoming a Computer Scientist, Communications of the ACM, Vol. 33, No. 11, p. 47–57, November 1990.

[7] S. H. Rodger and E. L. Walker, Activities to Attract High School Girls to Computer Science, Proceedings of the Twenty-seventh SIGCSE Technical Symposium on Computer Science Education, 1996 (to appear).

[8] W. Schwartz and K. Hanson, Equal Mathematics Education for Female Students, ERIC/CUE Digest, Number 78, February, 1992.

[9] E. Spertus, Why are There so Few Female Computer Scientists?, MIT AI Lab Tech Report 1315, 1991.

Panel

Positive Effects of Software Grants and Partnership Activities in Teacher Education

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Key Words: **teacher education, technology, collaboration, Microsoft**

The Beginnings

Our collaboration consists of a group of Teacher Preparation Colleges in New York State. We began six years ago because of a grant from IBM which networked 12 elementary schools in New York State and provided computers for their classrooms. As an add-on to that endeavor, IBM selected a college near each of the K–12 schools and gave the teacher education departments of each of those colleges a networked computer classroom and 20 PCs. The faculty in the twelve colleges did not know each other, nor did the elementary schools, and IBM held a meeting each year, for three years, in order to introduce the participants to each other.

As the teacher education faculty met at these meetings, it became evident to us that we shared many of the same problems: the faculty were, for the most part, not computer literate; the colleges we were in had too little in the way of support and what support there was usually went to the computer science, math, and business areas; the IBM software was insufficient; and we could not get online.

At Pace University, we felt that getting the faculty comfortable with computers was the first step but there was no funding to give the faculty time or resources to make this happen. We formed a second collaborative with the nine teacher preparation institutions in our immediate area and looked for funding. None of these schools were part of the IBM grant but they all were feeling the same pressures. We were successful in getting some funding to give half the faculty one course release time to take on the commitment to become comfortable with computers.

At the end of the IBM grant period which was for three years, we then had a faculty with some comfort with computers, machines which were by then out-of-date, and did not run *Windows*, and software that was equally out-of-date. We also had an excitement and a sense of commitment to bring technology into our programs, because we believed that computers had the power to change the way education happens. We had learned enough to know what we wanted to happen, but we again did not have the resources to make it happen.

We were also reluctant to give up the relationship we had built with the IBM higher education partners and so some faculty from this group arranged to meet for two days to share problems and concerns. The result of that meeting was an agreement to submit a "Partners in Education" proposal to the Microsoft Corporation.

The Microsoft Corporation has made a commitment to deal only with collaborative groups since they seem to feel that is more efficient and, although inadvertently, we had a collaborative group in place. Since the colleges that collaborated on this were spread out over about 400 miles, we attempted to set up a listserv for the group. There were still too many institutions who were not connected, so we wrote our first grant with the help of many telephone calls. Since one of the requirements of the program was that we present our results, we all arrived the day before our first conference and planned for the next year. That's been our pattern since, and we are now in the third year of the Microsoft grant.

Expected Results

All of us have begun using software extensively throughout our teacher preparation programs. At Pace, students are expected to turn in assignments done with word processing. Examples of software being integrated throughout the program include the following:

Creative Writer is used in the Children's Literature course and students produce alternatives to the traditional book report. *Creative Writer* and *Fine Artist* have also been used in Teaching of Foreign Language methods classes and the Language Arts methods class as well.

The Science and Social Studies Methods classes have used CD-ROM technology extensively. With the availability of programs like *Ancient Lands, Dangerous Creatures, Explorapedia Nature and People, 500 Nations, Oceans, Flight,* and so on, we've been able to teach the possibilities inherent in interdisciplinary curriculum in exciting ways.

Some of the faculty have been teaching students to produce multimedia in the methods classes and we hope that this semester we will team a sixth grade class and a Social Studies Methods class to build a multimedia unit.

The faculty use computers as tools constantly. We're all on e-mail and we've begun to get everyone using the Web. As part of the grant, Microsoft has given all the faculty a copy of *Microsoft Office* and, although we're still learning the various pieces, it's now a necessity for our own research and class preparation.

Most of the institutions found that they needed to institute a course in Educational Technology. As the years have gone by, it is the Ed Tech course that pushes the limits and permits us to try new things. As an example, my Ed Tech class will try to build the education student home page this semester.

Unexpected Results

We've each learned from the others. Because I was able to get some release time for my faculty to learn about technology and shared how successful that was in getting technology throughout the curriculum, faculty from the other institutions brought that information home and were able to duplicate that.

Cortland taught a very successful course for K–12 administrators which Pace is duplicating this spring. None of the colleges are near each other so we do not appeal to the same population. Pace requested some software to be used by our students in the schools in which they student teach and some of the other colleges did the same.

Brockport found that their faculty really used *PowerPoint* extensively for class presentations so I did a *PowerPoint* workshop for Pace faculty and found it very successful.

We've tried to get some of the teacher preparation classes at the different institutions online together but that's still not working smoothly although it is obvious at this point that it is only a matter of time before the students become part of the collaboration.

Within my own institution, this grant has given the School of Education visibility and credibility regarding technology. We've become recognized as a faculty that uses technology with our students and the results have been tangible. Each of the faculty members in the School of Education will receive a new multimedia computer for their office this year because as the Administration said, "we really use them."

Our collaboration is now in its seventh year and it is dramatically different. We use computers that didn't exist then to do things that none of us knew we'd be able to do. We recognized then that this technology had potential for schools but we're only now beginning to see that potential put to use. We're now online with each other and we do stay in touch. The chance to see what other faculty do and to trade ideas has been of great value and the updated software from Microsoft has provided a catalyst for change.

Project
NetPals: An Interdisciplinary, Multi-Site, Classroom Internet Project

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Key Words: Internet, e-mail, classroom, World Wide Web, interdisciplinary

Introduction

NetPals is a project that involves students in similar or different classes at two school sites sharing with each other a variety information over the Internet. It can involve students from virtually any subject area or discipline, and students at both schools need not be enrolled in a "computer" class, but it may be helpful if students at least one school are involved in this type of instruction. This project session description outlines the three phases of Project NetPals as presented at the NECC '96 conference.

Materials Needed

NetPals requires that each school have at least one computer (a computer lab is preferred), word-processing software like *ClarisWorks*, *Microsoft Works*, etc. ..., a modem, an Internet connection such as InforMNs, and e-mail communications software (such as *Eudora*). An LCD projector is also handy for demonstrations but is not absolutely necessary.

Procedure

Phase One: E-Mail

Students from both sites begin by creating an introductory document on the word processor in their respective computer labs. The introductions are a mini-biography including their name, age, grade, hobbies, extra-curriculars, interests, family, etc. .... These introductions are exchanged, and with the help of the teacher at each site, students are paired up with a "keypal" (like a pen pal) from the other school. New letters are exchanged that include a set of directions on how to get to one town from the other, and things to do for entertainment in each town like ordering a pizza or renting a movie. These letters are all created via the word processor and saved on a student disk. When it's time to send them, you simply copy the letter from within the word processor, paste it into a blank *Eudora* document and follow the procedure for sending a letter to your assigned keypal. Messages are received, printed, and read by the keypal students. Once this set of introductory correspondence is finished, then it is time to move to Phase Two of the project.

Phase Two: Webbing

After establishing keypals and learning some things about the keypal students and their towns, the next step was to have the students help each other out with class projects using the Internet and the information available online. For example, students from one class could each be assigned a country from around the world on which they would do a research project. Information for these projects would be obtained with the help of students from the class at the other location. The teacher directing the "research" class would instruct their students to e-mail their keypals. The e-mail should: a) explain the research project assignment and b) request that their keypal help them by performing an Internet search and locate ten "sites" on the World Wide Web that could be used to find information about their assigned country. The students receiving e-mail (the "helpers") are then to perform a Web search using *Netscape* to locate ten useful sites. With this accomplished, it's on to Phase Three.

Phase Three: HTML

Upon completing their Web exploration, the teacher of the "helpers" instructs their students on how to create a Web page with links to the ten sites they had found. Have these students create their Web pages using HTML editing techniques, include some graphics, and the clickable links to the information about the country their "researcher" keypal had requested that they find. The "helper" teacher would post these Web pages on an Internet Web server and have the Web page creators e-mail their "researcher" keypals with the HTML addresses. The "researcher" students who requested the information can then use *Netscape* to locate their keypals' Web page, and use this information to research and construct their report on the country they were assigned.

Project

Two Years of Technology Integration at the Horace Mann School: Planning, Implementation, and Assessment

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Key Words: **high school, middle school, curriculum, teacher training, assessment, integration**

The Synthesis Program at Horace Mann, a three-year initiative begun in the spring of 1994, has three major components. The first is a Mastery Assessment Program for all students grades 7–12, where each student in every grade is required to successfully complete a demonstration of age appropriate computer skills every year. Second is a series of instructional workshops given to both students and teachers together on specific topics and applications. The third element of technology integration consists of the training and support of technology pilot teachers. We consider this to be the cornerstone of the Synthesis Program which has as its goal getting technology into the hands of teachers who will themselves decide how best to use it in their classrooms. Eight teachers were trained in the first year, eight in the second, and sixteen more will be trained this year. Each of these teachers is supported throughout the year by one of the school's four Technology Specialists.

The "teacher centered" aspect of the Synthesis program has made the assessment of each project—as well as the program as a whole—challenging. Beginning this year, we will begin a new element of the program that will organize and assess teacher and student projects by a system of categories that we have developed. At present we have divided all of our projects into four categories: Presentation, Representation (modeling and simulation), Composition/Construction, and Communication. Our goals with this new assessment tool are three fold: First, we want to better understand what kind of projects are being attempted and which of these projects have been the most or least succes[illegible] Second, we will bring together teachers not just by subject but by the kinds of projects they are doing so that they can help one another and create a foundation for future projects. Third, with this additional information we will have a better sense of where we are and where we should be headed in the final year of Synthesis and beyond.

Society
China: Perspectives On Technology Education (ACM SIGCSE)

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Key Words: China, international, multicultural, classroom technology

In October, 1995, a group of thirty-eight educators embarked on a life-changing experience, as they traveled to the Republic of China to share ideas with the Chinese in the field of technology in education. Participants came from many parts of the educational community—classroom teachers, school administrators, college faculty, college administration, and business partners among them. The group hailed from locations across the United States—Hawaii to Puerto Rico.

The trip was arranged by an organization in Washington State called the People to People Citizen Ambassador Program. The organization was founded in 1956, by ex-President Dwight D. Eisenhower, who felt that the true avenue to world peace was not through government negotiation but rather through professionals in different countries yet in similar skill areas meeting and finding common ground.

The China group spent two weeks on the mainland, visiting Beijing, Hangzhou, and Shanghai. They were invited to schools at every level—from a pre-school day care center to the Universities. They visited classrooms, and computer labs, teacher's rooms and college bookstores. At each site, dignitaries from the school as well as the government, in some cases, were there to greet them, and wonderful Chinese traditions awaited them as they sipped tea and conversed with their colleagues.

In many upper level schools, computer labs are available. DOS machines are much more prevalent than Macintosh, although Mac was available in a few sites. Elementary schools (K–4) do not have a lot of formal learning on the computer. Formal computer classes seem to start at grades 5 or 6, and these with programming. LOGO was available at many schools that we visited, as well as Pascal, Ada, and C.

Classes were very large in size—whether the visit was to an elementary school or a high school, class sizes averaged between fifty to sixty-five students with one teacher. Obviously, children sat in formal seated rows, and were called on, for the most part, singly or in chorus. The group concluded that, based on the number of children alone, computers inside the classroom would be most difficult to manage. Therefore, in almost all instances, computers were located in labs, and in common areas.

Many of the daily activities in the schools that were visited reflected a more formal approach to learning. Children throughout the country dressed in uniforms, many resembling Boy Scout uniforms. Classes participated as a unit in "morning exercises" each day, a series of exercising instructions, usually taking place out on the playground, and participated in by the entire school.

On the other hand, children in China proved to be no different than anywhere else in the world when it came to greeting new visitors. In keeping with the Chinese tradition of gift-giving, delegation participants had been instructed to bring along small gifts, both for the children as well as the teachers and other hosting dignitaries. A life-long memory for all on the group will be the beautiful smiling faces on the young children, as a neon ball-point pen, or a glow-in-the-dark sticker was presented to them as they crowded around in the hallways.

Another memorable moment occurred when several in the delegation visited a high school English class. The teacher, to help the children practice their own English language, instructed the youngsters to "fire" questions at their American visitors about life in America. Questions were received such as "Did you ever meet Michael Jackson?" "What are teenager's favorite foods?" (In this particular city, there was no evidence of McDonald's, and the children had never heard of it!)

The extent of the experiences and the knowledge gained by the People to People Chinese Delegation in Computers in Education from this unique travel experience is far more than could ever be captured in this abstract, or at the society session. However, through slides, video, discussion, and this abstract, the group can share a small piece of all that they have learned.

Focus

Software on a Shoestring: Strategies for Low-Budget Software

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Key Words: **programming, software design**

Introduction

After over twenty years of software development on many platforms (PLATO, Apple, UNIX, DOS/Windows) I have sometimes been forced to hone a number of adaptive strategies to cover those instances when external or internal funding is either non-existent or insufficient to carry out software development needs. This happens when we find ourselves in research areas which are not currently "hot" and thus funding either becomes problematic or dries up altogether. Finally, there are those instances in which the research or development is "funded" but at insufficient levels, which results in forcing the researcher to either compromise or innovate in order to actually get something done.

What is needed is the laying-out of the techniques (not to say tricks) which are sometimes necessary in order to get good software designed where, those at funding agencies put it, "...the resource base in inadequate for project maximization."

The strategies which the author has evolved include:

Piggybacking

This involves bundling a needed project along with a funded project and making the needed project seem salient enough that the funder ends up happy to have funded both. Where this is not possible, it can be carried out piggybacked but labeled "models development" or "early directions." Not infrequently the needed project turns out to be more popular with the funder than the "official" project. It is not uncommon in all areas of the sciences to find researchers who build into the budgets of even modest projects activities euphemistically labeled "model-testing" in order to do work which every so often turns out to the sole genuine contribution of the research. A friend in a biological sciences area related that in the process of operating a large NSF research project he was able to justify the collection of thousands of slide and digital images which were used initially for simple analysis and later for the classroom demonstration portion for the project. He then used these images as the core of a centralized image library for classroom use which was accessed in all classrooms using a LAN server and displayed through presentation software (usually *PowerPoint*). This online source of almost endless combinations of flora and fauna helped numerous faculty members to win teaching awards for creative use of these materials in classroom situations, while in fact they always constituted merely a set of image files. They would never have come about in the first place, however, had the programming and preparation necessary to carry out this cataloged system been "piggy-backed" onto the larger project funded by external sources.

It is my suspicion that greater attention should be given to the possibilities to be found along this line, for many of us simply aggregate data and resources for a single project and leave little of lasting significance unless one counts a project report rarely even read by the oversight officer at the funding agency (I know this happens because I had one such officer ask me a question a month after the end of the project, the answer to which was contained in the first line of the executive summary of the final report).

In-Kind Exchanges

This involves hiring programmers using non-cash remuneration. Research projects almost always have room for many kinds of things to be done, some of which are more important to a programmer than money. For example, while doing transportation research and needing a specialized PLATO programmer, we exchanged the typing services of our hourly secretary on the programmer's dissertation in exchange for the actual programming. Curiously, the student thought he had taken us to the cleaners and yet we got thousands of dollars worth of programming for less cost than the secretary normally wasted anyway.

Much later, while designing a set of simulations of organizational life (which ended up being called BOSS and WORKER on the PLATO system), I found I needed a programmer conversant with the arcane requirements of the University of Illinois system. I fished around until I found the programmer whom many local hackers referred to as "the whiz," and I approached the undergraduate student about the project. On academic suspension at the time for poor grades, he was apparently an idiot-savant about PLATO programming, and had the nocturnal habits of an owl. I set up three appointments in my office and the fellow never appeared, usually calling the next day to say that something "came up." I had given up on the guy and was looking elsewhere when I bumped into the guy as I left late my building late one night after grading papers. He was just entering the entrance where the PLATO machines were located and he had a brown-bag "lunch" which he indicated he would consume at about 4 am and a huge bottle of Mountain Dew. Without asking about his missed appointments I asked if he were still interested in my project. He eagerly indicated that he was and that he had some ideas for making it better, but that he was a bit idiosyncratic about work hours and wanted to know if I would be flexible. What that meant was that he worked from about midnight each night until O'dark thirty on the system, and that he would sent me email when he had something he wanted me to see. All he wanted in return was to use the system under some account funded by my department (yielding a higher order of access to faculty than to students) and a letter of recommendation should I end up happy with the result. He cranked out workable drafts of both simulations within days, had them debugged by the weekend, and then proceeded to suggest interesting ways they could be tweaked to yield even more amazing results. One such innovation he suggested required the "employees" in the WORKER portion of the simulation to "wire" circuit-boards using a mouse and to listen to actual industrial noise over the headphones of a tape cassette while being harassed by a foreman. Some students became so angry with the experience that they stopped working (for which they were "fired" and denied access into the game until they were "rehired" after seeing me), and one student even smashed the tape cassette and had to replace it. I should add parenthetically that BOSS and WORKER were rated among the most popular PLATO simulations for several years, routinely attracting 3-400,000 hits per year on a system lacking sound and most animation capabilities. I should also add that my odd friend went on to become a much sought-after programmer for game software, apparently without changing his idiosyncratic habits to conform with anyone else's preconceptions.

More recently, I was able to get an undergraduate student to do some very involved programming on *Authorware* which my schedule did not permit me to finish, in return simply for permitting access to our microcomputer lab with it's high quality color scanners and printers and very fast Pentium computers. In such a situation, both parties clearly win and the result is work which might not otherwise be completed.

Credits for Programming

In an amazing number of instances it is possible to simply have good programmers at universities sign up as "individual studies" students, give them three hours of credit and get an amazingly large amount of labor from them with both parties ending up happy with the exchange. This can be rationalized because the programmer always learns a good deal about the subject matter (perhaps more than they would have from doing the more typical "readings").

An anecdote may clarify how this works. While working with a transportation engineer on a transportation planning and mode analysis study some years ago, my colleague and I came up with an idea a bit ahead of it's time. What we envisioned was called "Simulation Survey Technology" (SST) which called for the use of lifelike simulations to place respondents in situations in which the actions they chose could be used to inform future choices and options, thus being both a simulation and a survey of responses. At that time, using Apple II computers (this was sixteen years ago) we had to use an intelligent video tape machine with an RGB color board in the computer to interface the software and the industrial grade video tape player at the right points on the tape.

The programming necessary to integrate the two was complicated, requiring many loops which checked tape counter location, found video images on a hard drive and integrated those with text offering options and then routing responses to the right registers, ultimately saving them. We hired and paid two highly recommended programmers who produced elaborate and well-drawn flow charts but never yielded a workable program which did not lock up at some point. Finally, by a stroke of sheer luck I ran into a graduate student in the coffee area which our department shares with another department. This economics Ph.D. student asked why I was studying flow charts (myself trying to debug the last program). I told our sad tale only to have him reply that he had written many programs both for himself as well as others, including a teacher's grading program which was selling very well. On impulse I offered him the only compensation I could to induce him to help us, which was independent study credit in either civil engineering or sociology.

It turned out that he did, indeed, need out of program credit for his degree and (to my surprise) found it a highly attractive offer. That afternoon we did the paper work on his independent study credit, met at the transportation lab, and outlined our problem and the overall parameters of the controlling computer and the video tape machine. He took the technical manuals from the controller card and video tape machine and said he would work on it. I was not sure whether we had solved our problem or created another, and when I did not hear from him the next day I was leaning toward the latter prospect. Just before I left the lab that day he showed up with a disk and a printout of a program, which he said he had written on one creative burst, without flow charts or anything but his hand-written notes. The program contained over 10,000 lines of code, and while it was not without bugs, it did work the first time and only locked up when it encountered a problem which was of our design and not his. There were typographical errors and small fixes required but it did work. I later found out that he wrote it in one twelve hour stint, without even moving from the computer at any time, and that this was how he often worked on programming projects. Needless to say we tried to hire him for our research project, but he was singly intent upon finishing his Ph.D. in economics and went on very shortly afterward to a position in an urban university where, as far as I know, his remarkable talents are even now being wasted on econometric models of soy bean consumption. However, our experience points to the advantages of using this approach to getting important programming done.

Conclusion

I suspect that these examples merely scratch the surface of possibilities which many others needing programming have innovated. The only real problems inherent in such an approach are three: first, it is almost a matter of luck to find people with such skills and it can take a good deal of asking around, calling friends, etc. to locate the right person; second, it is difficult to know beforehand whether the person can actually program or whether they can merely the symbols and make a program run (real programmers see instantly through to a solution without the need for detailed and intermediate steps); and, finally, there is also a potential problem which emerges should the student turn out to be less than capable. In the last instance, my experience is that the less said among all participants the better (accept the work, roundfile it, give the *quip* *pro quo* agreed to and then move on). It is hoped that these suggestions have fostered some ideas for low-cost programming of which you may be able to avail yourselves.

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Key Words: **electronic, portfolio, alternative, assessment**

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Key Words: **technology, primary, curriculum**

Integrating Social Studies and Technology

Our Neighborhoods—*Creative Writer* (Microsoft); *EA*Kids Art Center* (EA*Kids)

Interactive Book—Imagination Express—*Destination: Neighborhood* (Edmark)

A Community is Where We Live, Work, & Play—Imagination Express—*Destination: Neighborhood* (Edmark)

Community Map—*Kid Pix* (Brøderbund)

Quiet As the Lady Washington—*Superprint* (Scholastic); *Kid Works 2* (Davidson)

ABC's Of Washington—*Creative Writer* (Microsoft)

Washington Product Map—*Kid Pix* (Brøderbund); *Superprint* (Scholastic)

Important Events in Washington—*Kid Pix* (Brøderbund); *Mac Timeliner* (Tom Snyder)

Official Washingtonian Certificate—*Kid Pix* (Brøderbund); *Award Maker* (Baudville)

Sturley's Movie—*Disposable Camera; Kids Studio* (Cyber Puppy)

Medieval Unit—*Fine Artist* (Microsoft); *Superprint* (Scholastic)

Civil War—*The Cruncher* (Davidson); *Creative Writer* (Microsoft)

If You Changed Your Name at Ellis Island—*A Scholastic Smart Book CD* (Scholastic)

Integrating Technology and Science

MacKenzie Watching the 'Eye'—*Amazing Animation* (Claris)

Save Our Earth Poster—*Kid Pix* (Brøderbund); *Creative Writer* (Microsoft)

Earth Day Magnets—*Flying Colors* (Davidson)

Habitats of the World—*Zoo Keeper* (Davidson); *Dangerous Creatures* (Microsoft); *PrintShop Deluxe* (Brøderbund)

Animals & Their Homes—*Creative Writer* (Microsoft); *Dangerous Creatures* (Microsoft); *PrintShop Deluxe* (Brøderbund)

ABC's of Bugs—*Kid Pix Studio* (Brøderbund)

Strange...But True—*The Multimedia Bug Book* (Workman/Swite); *HyperStudio* (Roger Wagner)

Slide Show—*Kid Pix Studio* (Brøderbund)

Simple Machines—*Creative Writer* (Microsoft)

Food Pyramids—*PrintShop Deluxe* (Brøderbund); *Storybook Weaver* (MECC)

HyperStudio Stacks—*HyperStudio* (Roger Wagner)

Starfish—*Aldus Persuasion* (Aldus)

Eye and Heart—*Amazing Animation* (Claris)

Integrating Language Arts and Technology

See You in a Hole, Mole—*EA*Kids Art Center* (EA*Kids); *PrintShop Deluxe* (Brøderbund); *Kid Works 2* (Davidson)

First Grade Friends—*PrintShop Deluxe* (Brøderbund)

Book Reports—*PrintShop Deluxe* (Brøderbund)

Collective Nouns—*Flying Colors* (Davidson)

Thank You Letters—*Creative Writer* (Microsoft)

Going On a Scavenger Hunt—*My First Incredible Dictionary CD-ROM* (Dorling Kindersley)

School Brochure—*Creative Writer* (Microsoft)
Student Portfolios—*HyperStudio* (Roger Wagner)

Integrating the Arts and Technology

Color Wheel—*Fine Artist* (Microsoft)
Symmetry—*Mirror Tool; Fine Artist* (Microsoft)
Line Art—*Kid Pix* (Brøderbund)
Watercolor Impressionism—*Watercolor Tool; Fine Artist* (Microsoft)
Pointillism Style—*Pointillist Fill Tool; Fine Artist* (Microsoft)
Surreal Landscape—*Gradient Tool; Flying Colors* (Davidson)
Mary Cassatt/Ludwig Van Beethoven Stacks—*HyperStudio* (Roger Wagner)

Holidays and Technology

Halloween in First Grade—*EA*Kids Art Center* (EA*Kids); *Creative Writer* (Microsoft)
Spooky Halloween Riddles—*Superprint* (Scholastic)
Don't Climb Out the Window Tonight—*Superprint* (Scholastic); *Kid Works 2* (Davidson)
Thanksgiving Stories—*Writing Center* (Learning Company)
December Letters—*PrintShop Deluxe* (Brøderbund)
I Am So Thankful—*HyperStudio* (Roger Wagner); Flex Cam
Abraham Lincoln/George Washington—*Kid Works 2* (Davidson)
Love Is…—*HyperStudio* (Roger Wagner)
Mother's Day Poems—*Flying Colors* (Davidson)
Third Grader's Mother's Day Stories—*PrintShop Deluxe* (Brøderbund)
Mom's Magnets—*Fine Artist* (Microsoft)
Easter Eggs—*Fine Artist* (Microsoft)

Integrating Math and Technology

Story Problems—*Creative Writer* (Microsoft)
Easy Add—*Colorforms* (Gryphon Software)
My First Times Booklet—*Colorforms* (Gryphon Software)
Skittle Math—*Cruncher* (Davidson); Apple Menu Calculator

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